FEBRUARY 16, 1939 FIRST AERO WEEKLY IN THE WORLD MAR 1 1939 REG. AT THE G.P.O. AS A NEWSPA

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FLIGHT

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The AIRCRAFT ENGINEER

OFFICIAL ORGAN OF THE ROYAL AERO CLUB

1873 .XXXV

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FLIGHT
The AIRCRAFT ENGINEER

FIRST AERONAUTICAL WEEKLY IN THE WORLD : FOUNDED 1909

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The Outlook

The Next Step

ALTHOUGH his lecture to the R.Ae.S. and I.A.E. on Thursday of last week was mainly a review of work done, Mr. Fedden did point a finger (for those who watched carefully enough to notice it) to at least one development in which the sleeve-valve engine is likely to lead to improvement apart from its fundamental advantages. The lecture, by the way, did justice to the three mainly responsible for the development of the sleeve valve: Mr. Harry Ricardo for early research work, the Bristol company for the subsequent development, and the Air Ministry as the "fairy godmother who had provided the wherewithal." But one feels that the lecturer might have said a little more about the difficulties. He did mention the troubles with the early sleeves, but of the difficulties encountered when an attempt was first made to manufacture on a production basis he said nothing. The sleeve-valve engine is now a good manufacturing proposition, but there was a time when things looked a little discouraging.

However, all this is by the way. The reference to future development occurred when Mr. Fedden spoke of controlled swirl or turbulence (and later, in the discussion, when it was referred to by Dr. Pye). After stating that experience with high-speed diesels had shown that direct injection of small quantities of fuel presented no considerable difficulties, Mr. Fedden said, "It should be possible to adjust the fuel/air mixture very accurately over a wide range of operating conditions, and to use fuels of low volatility."

Direct fuel injection into electrically fired engines has been extensively adopted in Germany recently. Apart from the fact that less volatile fuels can be used (which is a great advantage in Germany's particular case), direct injection should give slightly more power, because of the increased volumetric efficiency due to the cooling action of the spray. The great attraction, however, of direct injection is the more rapid engine acceleration possible, and the reduced risk of ice formation. Also the direct-injection engine will run satisfactorily in any attitude.

Research and Production

"ONCE a nation has embarked upon a program intended to develop its air strength to maximum effectiveness, the provision of adequate laboratory research facilities and the training of skilled research personnel become of fundamental importance. The major European powers at the present time are engaged on relatively large aircraft building programs which are being prosecuted under feverish pressure. Mere numbers of aircraft, however, are not in themselves sufficient for an adequate modern air force. It is of even greater importance that the aircraft be of the most effective design. The advances in aeronautical science are so rapid that assiduous attention to the subject cannot with safety be suspended for even a brief period."

This sentence occurs in the letter to Congress in the 24th Annual Report of the American National Advisory Committee for Aeronautics. It might be read with advantage on this side of the Atlantic. Are we, in the hustle and bustle of production (the word has become a sort of fetish just now) overlooking the vital importance of research? One cannot read this annual report of the N.A.C.A. without coming to the conclusion that now as in the past the tremendous progress made by American aircraft constructors during the last few years is and has been due in a very large measure to the lead given by American research.

Not only does American research equipment seem to be ahead of ours in a great many directions, but the

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THE OUTLOOK (CONTINUED)

whole outlook on the subject is wider, more "practical" and somehow less "academic" than in this country. And the reports and notes of the N.A.C.A. are issued quickly—and at a price which everyone can afford. In this country the reports are mostly out of date when they are published, and then they seem to be regarded as worth their weight in gold, the prices charged being quite ridiculously high. Why that should be so we have never been able to understand, especially when it is remembered that those excellent Air Ministry handbooks on aero engines are sold at a very low price.

American Equipment

WE cannot give here a list of American research equipment, but just as an example of its completeness may be quoted the wind tunnels which the laboratories of the N.A.C.A. control. There is an 8ft. 500 m.p.h. wind tunnel; the full-scale wind tunnel with a throat measuring 60ft. by 30ft.; a 20ft. airscrew tunnel; a 5ft. variable-density tunnel; a 7ft. by 10ft. tunnel; a 4ft. by 6ft. vertical tunnel; a 15ft. free-spinning tunnel; and two high-velocity jet-type wind tunnels of 11in. and 24in. throat diameters respectively.

The N.A.C.A. has recently had constructed three new pieces of research equipment: A 19ft. pressure wind tunnel which will permit the investigation of large models under almost free-flight conditions; a refrigerated tunnel for investigating ice formation, and a free-flight wind tunnel, 12ft. in diameter, for studying stability and control characteristics of aeroplanes.

In addition to these wind tunnels the sub-committee on aircraft structures has recommended, and the main committee has approved, that a laboratory for research on aircraft structures should be provided. In this country we rely on the work done by a small section of the R.A.E. and at some of the universities for this sort of research. It would be well if research—scientific and practical—at home could be given more support than it is at present receiving. In addition to the problems of the immediate future, and they are many and varied, there is a great need for long-range research, upon which it will largely depend whether, in five or ten years' time, we are ahead of or behind other nations in the quality of our aircraft.

Towards an Ideal

RECENT reports from America paint in glowing terms a new process said to have been invented by Col. Virginius Clark (of Clark Y wing section fame) by which aeroplane fuselages and wings can, it is claimed, be built of plastic materials in two hours by nine men. One need not take the reports too literally, as the evidence was given before the Monopoly Investigating Committee, and it was the patent phase which was being investigated. There is little doubt that Col. Clark, and his associates of the Bakelite Corporation and the Haskelite Manufacturing Corporation, have evolved a method of production which is rapid and cheap. Exactly how rapid and how cheap time will show.

In the meantime it is well to remember that we are not standing still in this country. Dr. Norman de Bruyne has been doing excellent work on plastics at Duxford, and the Airscrew Company of Weybridge is doing some very interesting and promising experimental development work with reinforced wood.

Last September we published an article in *Flight* describing a new process for impregnating and improving wood, developed by Moulded Components (Jablo), Ltd., and since then hollow wooden airscrew blades have been manufactured of laminated impregnated and compressed wood. In many ways this is an even greater achievement than making a fuselage or a wing, because the stresses imposed by centrifugal force are far greater than any encountered in the structure of the fuselage or wing.

Allied to but different from the problem of airscrews is that of rotor blades for gyroplanes. In this particular field Great Britain may be said to be well ahead, as rotor blades made of impregnated and compressed wood have been flying for some months and have given complete satisfaction.

It is scarcely an exaggeration to say that when we come to make engines of 2,000 h.p. or more, the only way in which we can use them practically will be by fitting to them airscrews of a material which not only will have good weathering qualities, but which is graded in density so that the strength is everywhere proportional to the local stresses. The hollow compressed and impregnated airscrew blade seems to have these qualities, and manufacture is certainly no very difficult matter.

For fuselages and wings the density need not be so great, and consequently the pressures required can be a good deal smaller, a fact which will facilitate manufacture. There is no fundamental reason why a complete aeroplane should not be built in accordance with this system. If the fuselage is made of symmetrical cross-section, the number of dies required for the quadrants is not great, nor are the total areas to be pressed, so that presses of relatively modest dimensions would suffice.

Forthcoming Events

FEBRUARY.

Thurs., 16th. R.Ae.S. Lecture*: "Ignition Problems," by Dr. G. E. Bairsto, M.I.E.E., F.Inst.P.
Manchester Civil Air Guards: Dance, Sale Lido.
R.Ae.S. Portsmouth Branch Lecture: "Steel Tubes for Aircraft," by Walter Hackett.

Fri., 17th. Cinque Ports Flying Club: Annual Dinner and Dance, Majestic Garden Hotel, Folkestone.

Sat., 18th. Rugby: R.A.F. v. Royal Navy at Twickenham.

Tues., 21st. R.Ae.S. Lecture: "Duct Design," by Mr. G. N. Patterson, Ph.D., A.F.R.Ae.S.

Thurs., 23rd. R.Ae.S. Portsmouth Branch Lecture: "Variable-pitch Airscrews," by F. C. Lynam, A.F.R.Ae.S., A.F.I.Ae.S.

Fri., 24th. York and Leeming Flying Club: Annual Ball, Harrogate.
D.H. Technical School: Annual Ball, Hyde Park Hotel, Knightsbridge, 9 p.m.

Tues., 28th. Hampshire Aeroplane Club: Annual Dinner and Dance, South Western Hotel, Southampton.
R.Ae.S. Isle of Wight Branch Lecture: "Manufacture of Steel Alloys," by J. G. Hopcraft, M.C., A.M.I.Ae.E.

MARCH

Thurs., 2nd. R.Ae.S. Yeovil Branch Lecture: "Lysander in India," by F. W. Burnard.
R.Ae.S. Lecture*: "Testing Stability and Control," by Ing. A. G. von Baumhauer.

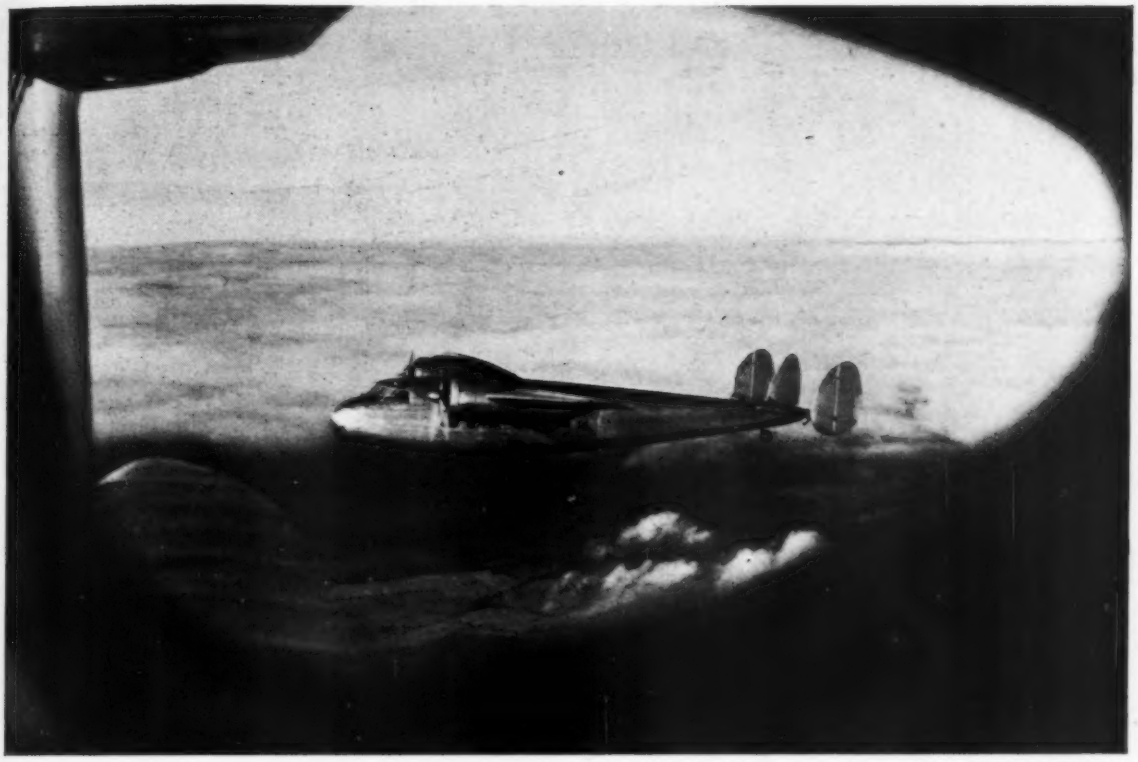
Tues., 14th. R.Ae.S. Belfast Branch: Film on Steel Making, with commentary by J. G. Hopcraft, M.C., A.M.I.Ae.E.

Thurs., 16th. R.Ae.S. Lecture*: "Relative Merits of Carburetters and Direct Petrol Injection," by J. E. Eilor, F.R.Ae.S., and F. M. Owner, F.R.Ae.A.

APRIL.

Thurs., 20th. R.Ae.S. Lecture*: "Possible Steel Developments," by Dr. T. Swinden, F.R.Ae.S.

* All these lectures take place at 6.30 p.m. at the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1.



"Flight" photograph.

THE DE HAVILLAND 95

A Medium-sized Transport with Wide Applications : The First All-metal Machine from the Hatfield Factory Described : A Design to the Newest Formula

WHEN a commercial machine is introduced to airline operators and prospective purchasers they ask two questions. In the first place they want to know what the machine will do, and in the second why a particular form of construction or a certain aerodynamic and general layout was decided upon.

In the case of the D.H.95 or Flamingo, the first question is easily answered. It has been laid out as a medium-sized civil type with applications which are as universal as design considerations allow. It is not a special-duty type, and can be operated with accommodation varying from twelve to twenty seats. While the performance in the matter of speed and range is intended to equal or to better that of any contemporary transport type, very considerable attention has been paid to safety considerations.

In the present state of aerodynamic knowledge a high cruising speed now inevitably means a comparatively high landing speed, but designers still have it in their power to ensure that the flying characteristics at speeds near the stall are as safe and normal as possible. The need for safe low-speed qualities is all the more noticeable nowadays when airline flying is so often carried out in weather conditions which involve long periods of blind flying followed sometimes by a virtually blind approach to the terminal aerodrome.

The reason for the fact that the 95 is of all-metal construction—actually the first of such construction to be produced by De Havillands—might simply, but not too accurately, be explained as the result of demand. Operators expect all-metal construction and, therefore, it must be offered to them. This, however, is obviously not the whole story. There are no very intrinsic advantages in all-metal construction as such. In fact, for many purposes, the older methods have distinct advantages. Only when quantity orders may be expected is the all-metal machine an economically reasonable proposition, while in such circumstances it is, for production reasons, the only possible means of construction.

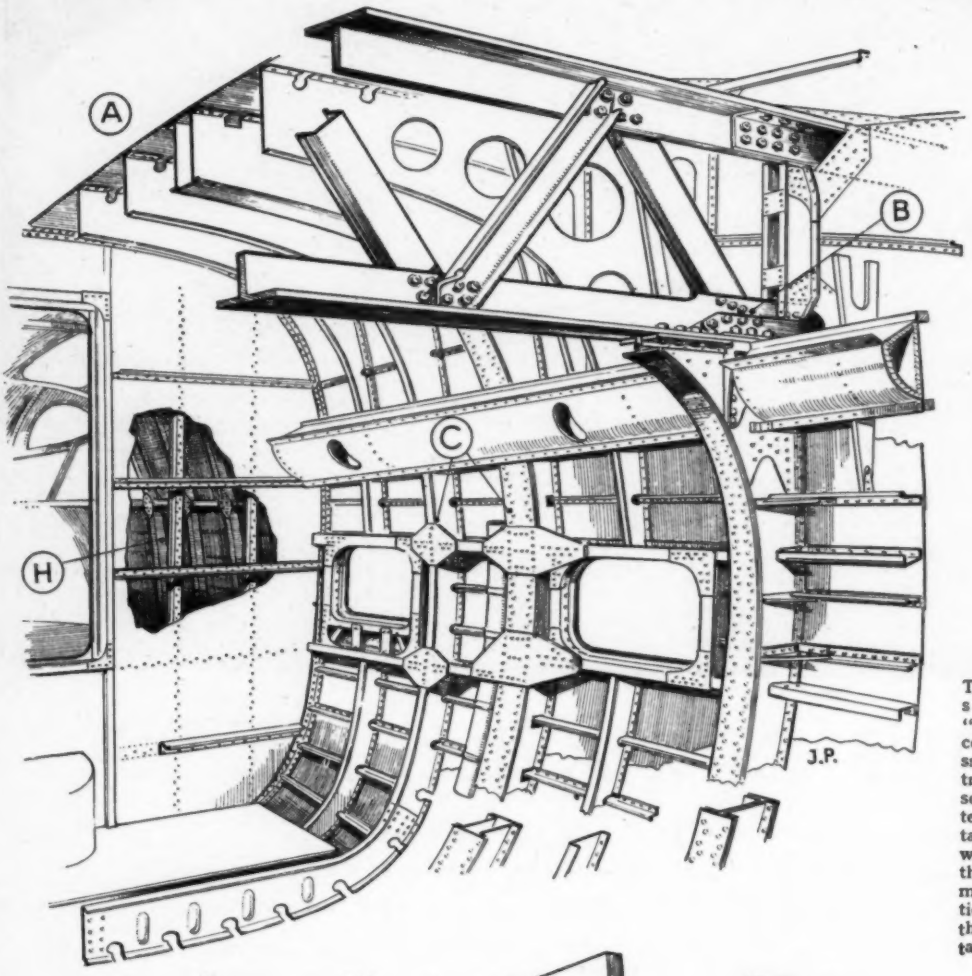
Changing ideas in the world of air transport on the subject of financial assistance have made the 95 possible. Without the expectation of a fair series of orders for such a type it would not be possible to go to the expense of laying down jigs for large-scale manufacture. With a very reasonable hope of direct and indirect support and assistance from our own Air Ministry the 95 prototype has been built and preparations made for the production of a series at a cost which should make it an attractive proposition both at home and abroad.

The particular size was chosen by the designers as being that most suitable for general use, while a twin-engined power plant was preferred for its simplicity, particularly as it was possible in the circumstances to provide a really adequate power reserve. This reserve is necessary to ensure a good take-off from high altitude or tropical aerodromes, and from those which are small or with somewhat obstructed surroundings.

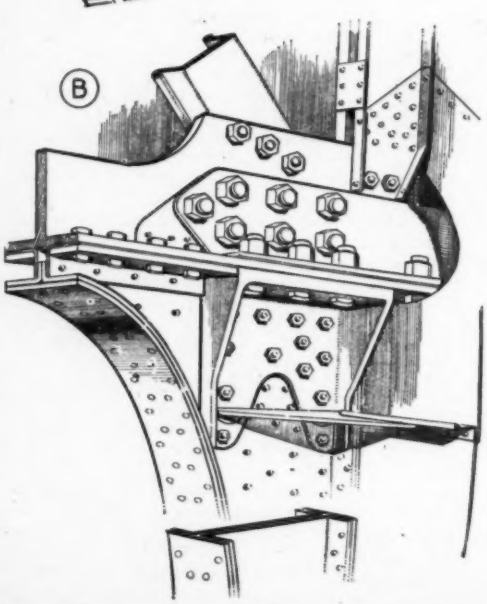
The power reserve gives an adequate single-engined performance. The Flamingo is designed to cruise at only 56 per cent. of its maximum power at a speed of 204 m.p.h. At this speed the machine carries 3,505 lb. of payload for 600 miles at a fuel consumption of 64 gal. per hour.

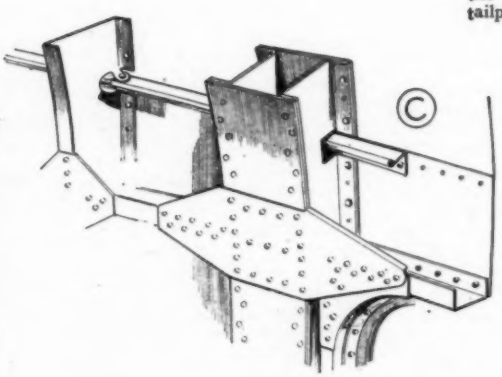
The use of large-diameter airscrews, geared to run at

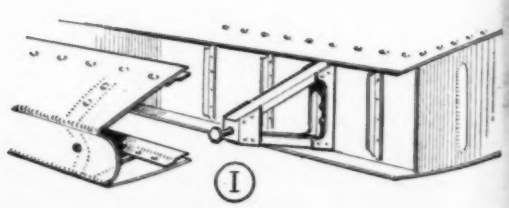
STRUCTURAL DETAILS of the D.H.95

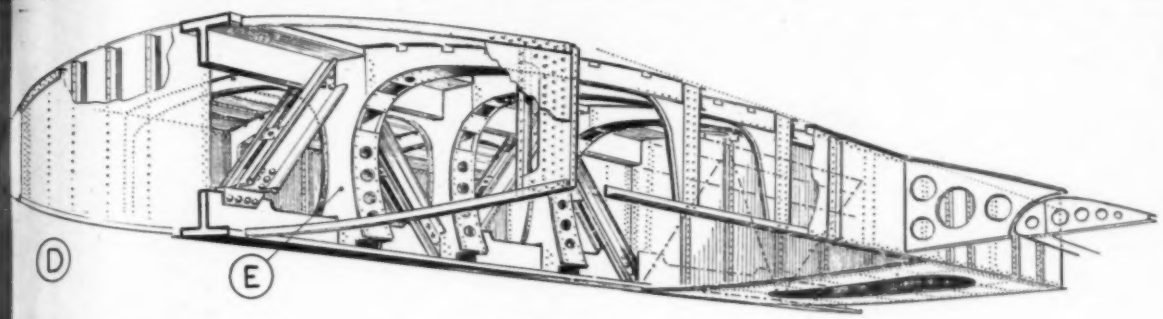


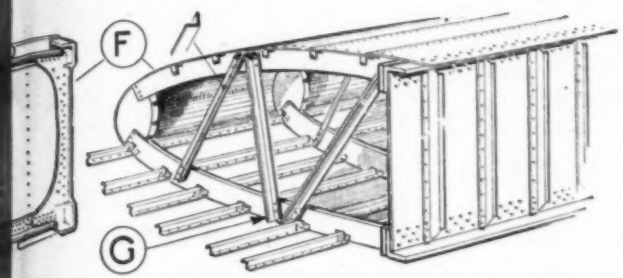
The sketch on the left shows the general "theme" of the fuselage construction, while the smaller sketches illustrate, to a larger scale, some of the more interesting structural details. The single main wing spar which runs through the fuselage is made up of extruded sections. Sketch I shows the construction of the tailplane trailing edge.

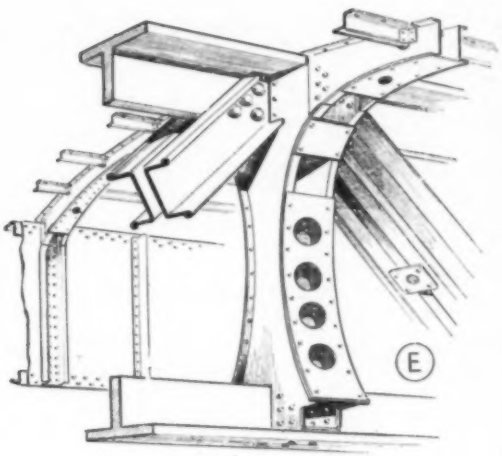


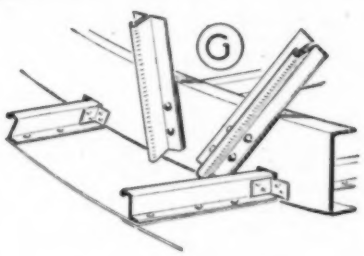


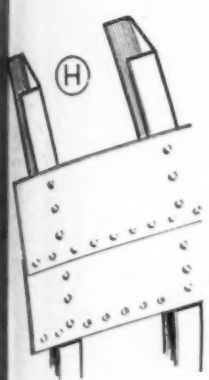




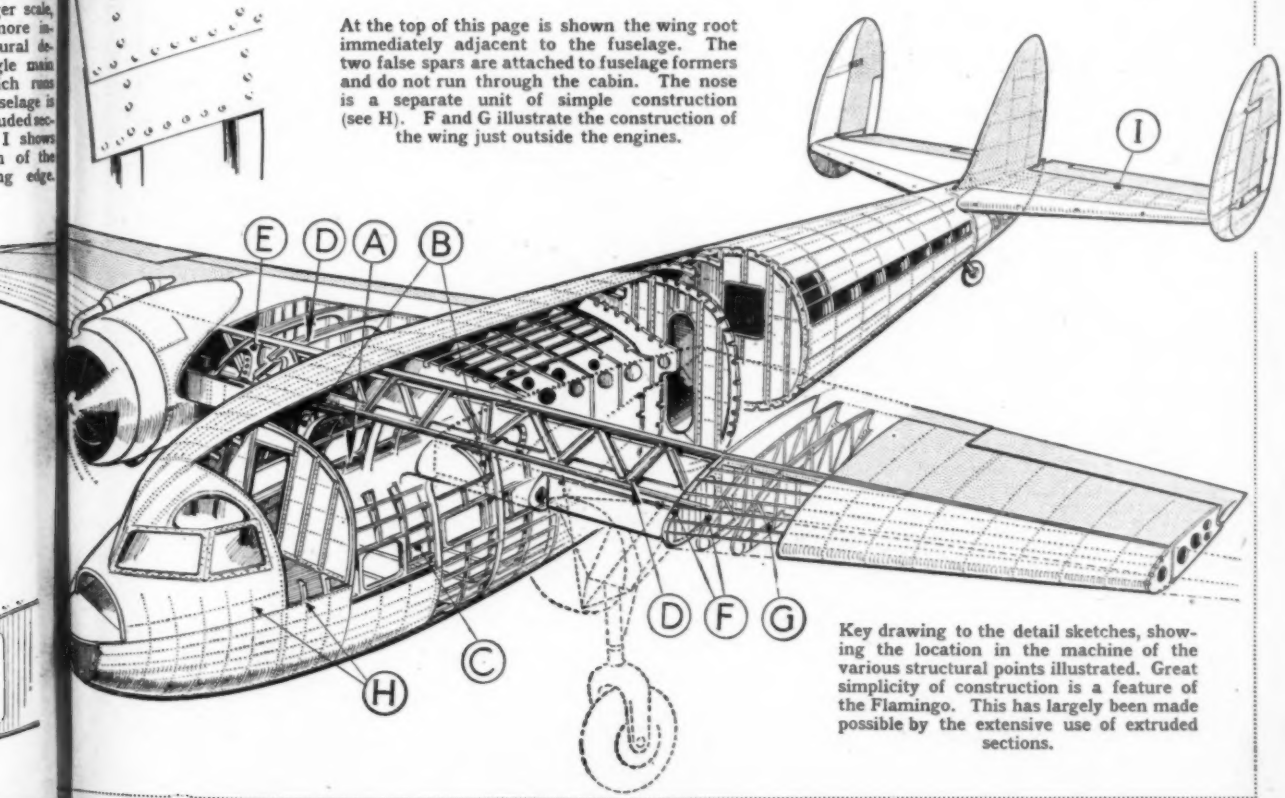








At the top of this page is shown the wing root immediately adjacent to the fuselage. The two false spars are attached to fuselage formers and do not run through the cabin. The nose is a separate unit of simple construction (see H). F and G illustrate the construction of the wing just outside the engines.



Key drawing to the detail sketches, showing the location in the machine of the various structural points illustrated. Great simplicity of construction is a feature of the Flamingo. This has largely been made possible by the extensive use of extruded sections.

half engine speed, means that the full available power for take-off may be efficiently converted into thrust, while the use of constant-speed airscrews—later to be full-feathering Hydromatics—means that this thrust efficiency is available during the initial climb as well as at the take-off. Large airscrews mean also that the engine diameter is small in relation to the airscrew disc, so that little power is wasted through slipstream interference.

A high-wing arrangement was chosen for a number of reasons. Those normally considered by the operator are fairly straightforward: the passengers obtain a better view, while the fuselage may be both deeper and so near the ground that there are few personal or freight-loading problems. Aerodynamically, the high-wing type has the benefit of an unbroken upper wing surface between the two engines.

In this particular machine the latter are carried well below the chord line, so that there is little disturbance of airflow. This unbroken surface shows its advantages at low speeds and high angles of incidence, when the even distribution of lift over the span reduces the likelihood of vicious tendencies at or near the stall. During the take-off and the approach the characteristics are further improved by the use of Handley Page slotted flaps which increase the lift quite considerably even when they are in the fully-down (53 deg.) position. For the take-off, when they are lowered to the 25-degree position, extra lift is available with little of the usually attendant drag.

It is worth noting here that with a full load the 95 can take off in 250 yd., and be at a height of 170ft. after a "run" of 650 yards. Within two miles of the start of the take-off (at a climbing speed of 100 m.p.h.), the machine can be at 1,800ft. if full take-off power is used for the period.

While on the subject of safety, two other little points should be mentioned. Either one of the two engine pumps is capable of supplying sufficient fuel to both engines for maximum power. Even if both the pumps fail, the position of the tanks means that gravity would still be available to provide the necessary flow. The retractable undercarriage, too, has three alternative methods of operation. If the hydraulic pumps fail there is an emergency supply of compressed air with separate pipe-lines, while there is a stand-by hand-pump system which is independent of either.

Very briefly, the structure of the Flamingo might be described as an interesting example of the translation of wood into metal. The designers have used many of the best features of normal wood construction—at least where the fuselage is concerned—and have obviously not felt themselves bound to follow previous ideas in metal stressed-skin layout.

The details are described later, but it should be said, by way of an introduction, that one of the most important features in the design is the way in which accessibility and interchangeability have been considered. For instance, the two halves of the tailplane may be reversed, while the wing, excluding the continuation of the main spar across the fuselage, is in four pieces, so that, when necessary for packing purposes, the machine's width can be reduced to a matter of 9 feet when the engine-carrying stub wings and the outer sections have been removed.

The fuselage is built in two separate parts largely for reasons of ease of production, though the fact would reduce rebuilding time in the event of a minor ground mishap. The wing tips, too, are detachable, and these are undoubtedly the most vulnerable parts of an aircraft.

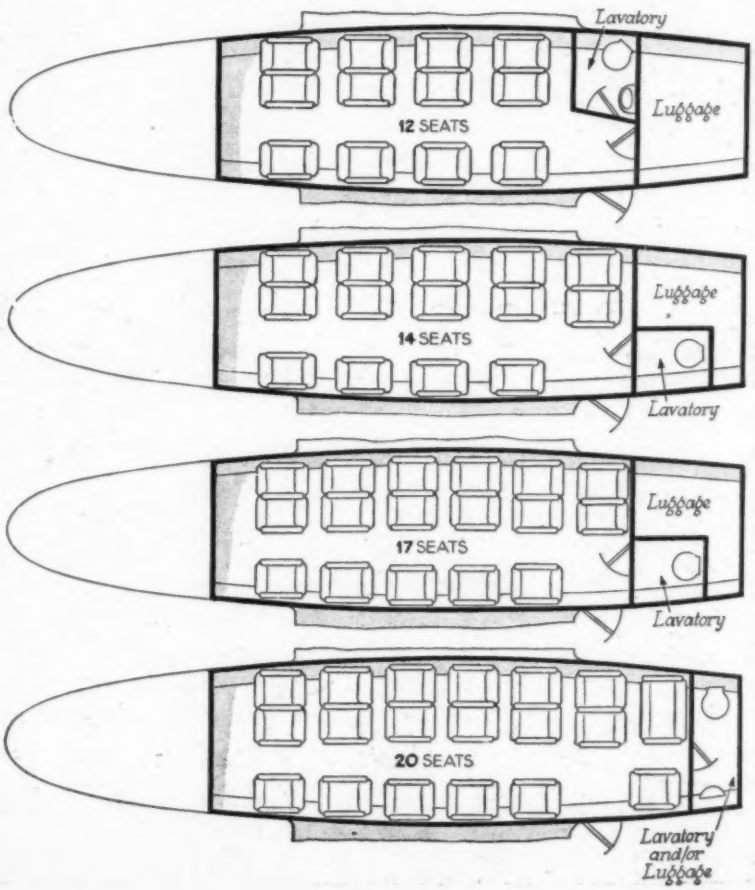
Operators who are endeavouring to make a small fleet do the maximum amount of work will be interested in the way in which the two Perseus engines are not only quickly removable but interchangeable. When one is taken out the various leads are merely detached at the bulkhead, while the accessory gear box remains mounted on the spar. An engine can, in fact, be changed in rather less than an hour.

In the works the necessary jigs have been split up so that the maximum amount of work can be done on each section of the machine without the hold-ups caused by the fact that only a certain number of men can work together in one place. This splitting-up also economises floor space. At the moment several 95's are in course of construction, and the production plans are well advanced for the quantity manufacture of the type.

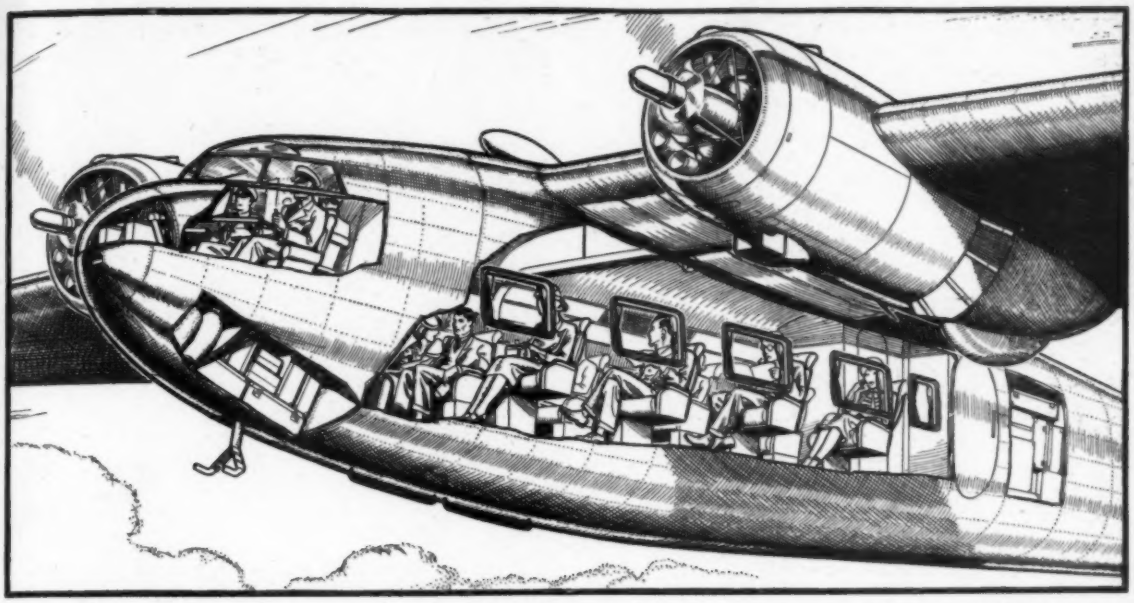
Passenger Accommodation

There are four different cabin arrangements for the 95. Those for twelve, fourteen or seventeen passengers may be had without extensive alterations, though the twenty-passenger arrangement involves certain structural modifications, which must be incorporated at an early stage in the manufacture of the machine.

Figures by themselves do not convey any real idea of cabin size, but for what they are worth here are the main cabin dimensions of the Flamingo: Maximum width, 7ft. 6in. (2.29 m.); height, 6ft. 7in. (2 m.); width of seats inside armrests, 19in. (0.48 m.); and width of gangway, 14in. (0.356 m.). The length of the cabin varies with the seating arrangements, that for the twelve-seater being 15ft. 11in. (4.85 m.); for the four-



How the seating is arranged in the four different versions of the D.H.95. It will be seen that only in the twenty-seater is any structural change necessary, the rear bulkhead being moved farther aft.



In this drawing the general arrangement in the long-range twelve-seater version is shown. It will be seen that freight and a certain proportion of luggage is carried under the raised floor of the pilot's compartment. Various items of equipment, including the rear of the instrument panel, can be reached through the hinged nose.

teen-seventeen seater 19ft. (5.8 m.); and for the twenty-seater 21ft. 8in. (6.6 m.). In addition to the normal windows there are four which may be used as emergency exits, while there are two exits in the roof, one in the passenger's compartment and one in the control cabin. The windows are of the double-pane type, which provide insulation against sound and cold. The air in the cabin is steam-heated and the temperature is controlled, while each passenger has, as usual, an individual supply of dry cold air.

Structurally, the most interesting feature of the Flamingo is the wing, which is made up in four sections, consisting of a pair of stub wings and a pair of outer wings. The former carry the engine and undercarriage assemblies, the fuel tanks, and the inner section of the flaps.

The centre section has one main spar (a lattice girder of extruded aluminium alloy) and the two auxiliary spars, which are Wagner beams with alloy extruded flanges. The undercarriages and the engine mountings are carried on rigid bulkhead ribs lying transversely between the spars. The four fuel tanks, two on each side of the main spar, are carried outboard

DE HAVILLAND D.H.95
Two Bristol Perseus XIIc Engines

Dimensions and Loadings.

Span	68ft. (20.70 *m.*)
Length overall (tail up)	50ft. 7in. (15.45 *m.*)
Width (extension planes and airscrews removed)	25ft. 4in. (7.73 *m.*)
Packing width of fuselage (wings and stubs removed)	9ft. (approx.)
Height overall (tail down)	15ft. 3in. (4.65 *m.*)
Wing area (including fuselage centre section)	639 sq. ft. (59.3 *sq. m.*)
Power loading (17,000 lb. or 7,710 *kg.*) at take-off, power (1,780 b.h.p.)	9.55 lb./b.h.p. (4.27 *kg/c.v.*)
Span loading	3.68 lb./sq. ft. (18.0 *kg/sq. m.*)
Wing loading	26.6 lb./sq. ft. (13.0 *kg/sq. m.*)
Flap chord	20 per cent. of wing.
Flap area	71 sq. ft. (6.60 *sq. m.*)
Tailplane area (gross)	73.8 sq. ft. (6.86 *sq. m.*)
Elevator area (total)	50.6 sq. ft. (4.70 *sq. m.*)
Fin area (total)	38 sq. ft. (3.53 *sq. m.*)
Rudders area (total)	36.7 sq. ft. (3.41 *sq. m.*)
Aileron area (total)	46.0 sq. ft. (4.27 *sq. m.*)
Undercarriage track	20ft. 8in. (6.30 *m.*)

Weights.

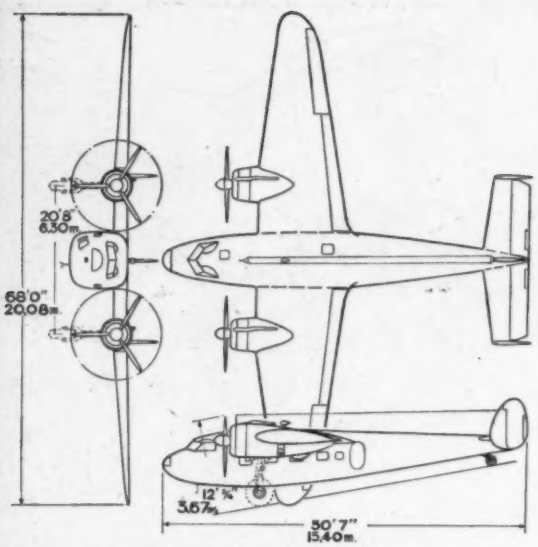
	With 1,000 miles (1,610 *km.*) range in still air.		With 500 miles (805 *km.*) range in 40 m.p.h. headwind (64.5 *km/hr.*)	
	lb.	*kg.*	lb.	*kg.*
Tare weight (12-seater to standard specification, including 200 lb., 90 *kg.* allowance for radio, but excluding automatic pilot, parachute flares, de-icing equipment)	11,325	5,142	11,325	5,142
Crew of three	510	230	510	230
Fuel 314 gals. (1,428 *litres*), at 7.5 lb/gal. (0.75 *kg/l.*)	2,354	1,066	—	—
Fuel 195 gals. (1,428 *litres*) at 7.5 lb./gal. (0.75 *kg/l.*)	—	—	1,462	663
Oil 22 gals. (100 *litres*) at 9.0 lb./gal. (0.9 *kg/l.*)	198	90	198	90
Payload available for passengers, luggage, mail and freight	2,613	1,182	3,505	1,585
Total all-up weight	17,000	7,710	17,000	7,710

Engine Power.

	Boost cm. of lb./sq. in. mercury.		Engine R.P.M.	B.H.P.	Altitude. ft.	Altitude. *m.*
Max. cruising	1.25	6.5	2,250	655/685	S.L.	S.L.
Max. climbing (international rating)	1.25	6.5	2,250	680/710	4,000	1,220
Max. take-off	3	15.6	2,700	865/890	S.L.	S.L.
Max. economical cruising	−1	−5.2	2,200	530	9,000	2,750
Max. for level flight (5 min.)	1.25	6.5	2,600	815	6,000	1,830

Performance
Loaded to 17,000 lb. (7,710 *kg.*)

Maximum economical cruising speed at 10,000ft. (3,050 *m.*) with 500 b.h.p. per engine	204 m.p.h. (328 *km/hr.*)
Maximum economical cruising speed at sea-level with 485 b.h.p. per engine	184 m.p.h. (296 *km/hr.*)
Maximum continuous cruising speed at 5,000ft. (1,525 *m.*)	227 m.p.h. (365 *km/hr.*)
Maximum all-out level speed at 7,500ft. (2,290 *m.*)	243 m.p.h. (391 *km/hr.*)
Take-off run in 5 m.p.h. (8 *km/hr.*) wind (on 17,000 lb.)	250 yd. (228.5 *m.*)
Height at 650 yd. (600 *m.*) from rest in 5 m.p.h. (8 *km/hr.*) wind	170 ft. (52 *m.*)
Landing run in 5 m.p.h. (8 *km/hr.*) wind	275 yd. (251.5 *m.*)
Rate of climb at sea-level on take-off power	1,500 ft./min. (457.5 *m/min.*)
Rate of climb at sea-level on climb power	1,050 ft./min. (320.5 *m/min.*)
Time to climb to 5,000ft. (1,525 *m.*)	4.7 min.
Time to climb to 10,000ft. (3,050 *m.*)	10.6 min.
Time to climb to 15,000ft. (4,575 *m.*)	21.0 min.
Absolute ceiling	20,150ft. (6,150.0 *m.*)
Service ceiling	18,500ft. (5,650.0 *m.*)
Fuel consumption at maximum economical cruising speed at 10,000ft. (3,050 *m.*)	64 gals./hr. (291 *litres/hr.*)
Air miles per gallon	3.18 m.p.g. (1,125 *km./litre*)
Ultimate range with full fuel, 410 gals. (1,860 *litres*)	1,305 miles (2,100 *km.*)
Absolute ceiling with one engine stopped	8,000ft. (2,440 *m.*)
Rate of climb with one engine stopped	150 ft./min. (45.7 *m/min.*)
Rate of climb at sea-level with one engine stopped and other at take-off power	250 ft./min. (76.2 *m/min.*)



The D.H.95 in schematic plan, elevation and frontal aspects.

of these bulkheads, while tank inspection covers are integral with the under surface of the wings. The main spar is continued through the fuselage, while the auxiliary spars are attached to two strengthened hoops in the fuselage structure.

The outer wings, which are quickly detachable, are made up of a stressed skin " D " section spar in which the web and the booms form a Wagner beam, while the nose of the spar itself forms the leading edge. The covering is of Alclad sheet, and the extruded sections are of light aluminium alloy. The ribs and formers, also of alloy, are riveted to the spar stiffeners, and the aileron hinge brackets and the outer sections of each flap are carried on the stronger ribs. Aft of the spar the wing is fabric-covered, though there are all-metal wing tips, these being detachable for ease of replacement in the event of damage. In the stub wings are hinged panels giving access to the engine controls, hydraulic pipelines, electrical leads, and fuel pipes, while jacking points are provided under each wing slightly outboard of the engines.

The ailerons are carried on three hinges and located by the central one only. An Alclad web beam forms the main spar of each aileron with a " D " section torsion nose-piece; aft of this spar are pressed Alclad ribs, fabric-covered. Differential control is used as on all D.H. machines, for the operation of the ailerons, to give a larger upward than downward movement and thus reduce drag.

The actual wing section employed in the Flamingo is a modified R.A.F. 34.

Retractable landing lights are fitted to each outer wing, these being flush with the surface when not in use. They have been specially designed by Rotax and their retraction movement is controlled by a small electric motor through a reduction gearing, a clutch being used to avoid any possibility of overload. The same firm is responsible for the navigation lights (with Osram lamps, which are used throughout for exterior and interior lighting), the engine starter, the cooling-gill motor, the vacuum pumps and for the undercarriage warning equipment.

The good take-off and landing characteristics of the Flamingo are partly the result of fitting Handley Page trailing-edge slotted flaps. These extend from the sides of the fuselage to the ailerons, each main section being in two parts. Rapid dismantling is possible because of the special hinge design, and these hinges are provided with appropriate inspection doors. For optimum take-off a small flap angle is normally used, the flaps being fully depressed for landing. Any desired intermediate setting can be selected by the pilot through a lever under the centrally placed control box. This operates, through Exactor hydraulic controls, a pre-selector valve situated in the wing, close to the ram.

The operation of the flaps is hydraulic, through a ram acting directly on a parallel-motion hinge linkage system housed just inboard of the joint between the stub wings and the outer panels. This hinge linkage picks up at the central end of each part of the flaps, the other hinges at the outboard and inboard extremities being provided with a similar linkage system. No part of the hinge system protrudes outside the boundaries of the aerofoil.

The structure of the flaps comprises, in the first place, a stressed skin nose of " D " section, made up of a channel-section beam and Alclad sheet conforming to the profile of the leading edge and stiffened with formers. Aft of this are ribbed pressings of Alclad riveted to the channel beam and nose skin. Recessed into the ribs is a tube of oval section which forms the trailing edge. The flaps are fabric-covered.

A notable feature of the fuselage design is its division into two sections, the front portion being detachable for replacement in the event of damage. All pipes and controls, of course, have joints at the junction of the two portions.

The first section extends from the nose to the bulkhead behind the pilot's cabin, and is built of channel-section Alclad formers covered with Alclad sheet, but having no longitudinal stringers This nose section includes the whole of the control cabin and its controls, with the seats for two pilots and a radio operator, the instrument panels, accumulators, wireless crates, mail compartment, and front luggage hold. Above the floor level, ahead of the cabin, the nose is hinged to give access to the two accumulators, the controls, and the rear of the instrument panels. Even in flight it is possible, through the provision of detachable panels in the cabin roof, to obtain access to controls and piping. On the starboard side of the nose are large doors for the mail and luggage compartments, these being arranged at a convenient height for loading on the ground.

The second section of the fuselage, which contains the passenger cabin, toilet room, and luggage hold, extends aft from the pilot's bulkhead to the rear end of the fuselage, and is constructed of Alclad formers of channel section, extruded stringers of light aluminium alloy, and Alclad sheeting. Under the floor are special keel members and strengthened rings to protect the machine in the event of an emergency landing with undercarriage retracted. In the rear bulkhead of the luggage compartment is a hatch giving access to a walkway for the inspection and maintenance of the controls, fittings, and structure in the rear portion of the fuselage.

The fuselage itself terminates in a completely detachable " tent" fairing, the removal of which gives access to the tail-wheel mounting, tailplane, elevator attachments, and controls for the elevators and rudders.

The stressed skin tailplane is fully cantilever with three stressed-skin fins, all-metal fabric-covered elevators, and two all-metal fabric-covered rudders. Trimming tabs are fitted to the elevator and rudders. The most interesting feature of this unit lies in its port and starboard interchangeability. The outboard fin and rudder can be used on either side, while each half of the tailplane itself is similarly reversible.

Structurally, the tailplane is essentially a two-web stressed skin box beam with the nose and rear portions detachable—the latter being secured by five bolts. The elevator is carried on light alloy outriggers and consists of an Alclad " D " nose with internal diaphragms and pressed Alclad ribs. Elliptical steel tubing is used for the trailing edge. The fins are similar in construction to the tail plane and the rudders to the elevators.

The Undercarriage

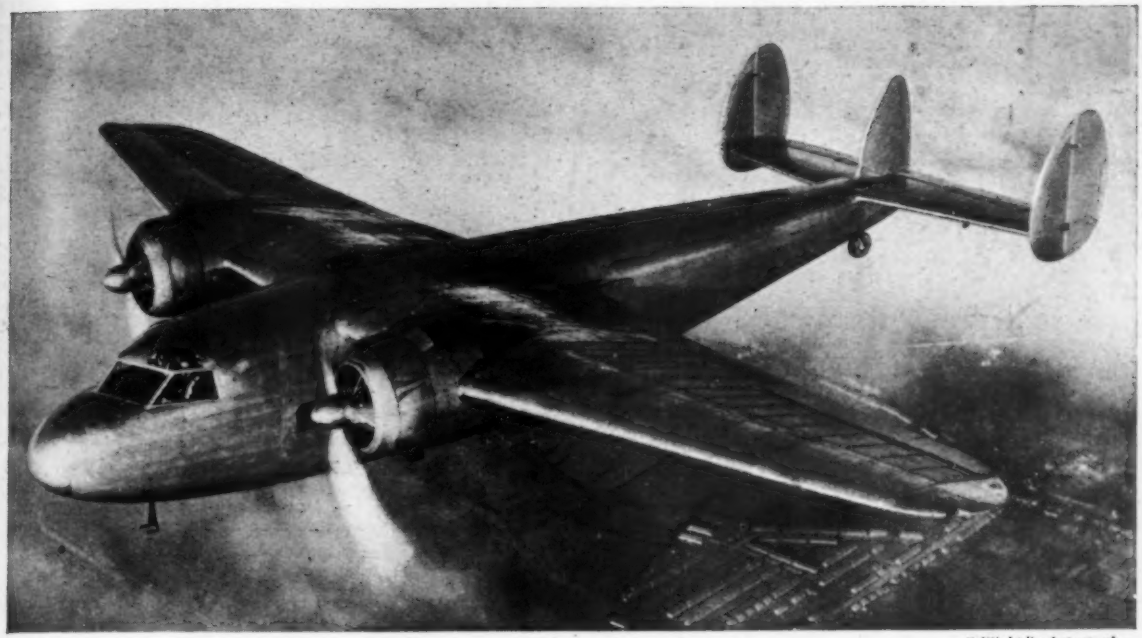
To provide aerodynamic balance, the hinges of both the rudder and the elevator are set back. The two halves of the elevator are statically balanced, each with an external weight on its under side. These balance weights may easily be reversed if the elevator halves are interchanged.

While the trimming tabs are operated by a screw jack driven by a chain and sprocket from a flexible shaft, the rudder and elevator are operated through a push-rod system connected to cables. Needless to say, inspection doors are provided at all points where the control system must be reached.

A single Lockheed cantilever compression leg, retracting rearwards into the engine nacelle, is the "core" of each half of the undercarriage, the unit on each side of the fuselage being interchangeable. On each leg and wheel fork are fixed fairings which follow the contour of the rear cowling and leave a small portion of each wheel protruding. Retraction of the undercarriage takes eight seconds and is affected by a Dowty high pressure hydraulic jack working on a cut-off pressure of 1,100 lb./sq. in. from an acumulator charged by either or both engine pumps. Actually, a pressure of 450 lb./sq. in. is sufficient to operate the gear under maximum load.

The wheels (10in. × 16in.) are of Dunlop manufacture, with tyres which give high braking efficiency. The wheels are carried in forks constructed of riveted Alclad sheet and attached to the compression leg by bolts, shear bushes and screwed rods.

The removal of four Simmonds nuts and bolts, which hold the axle caps to the forks, and the Avery coupling on the brake pipe-line, permits the complete assembly (wheel, axle, and Bendix two-leading-shoe hydraulic brake) to drop free. A special casting is supplied to facilitate wheel removal. This fits on each side of the fork, enabling the machine to be lifted by an ordinary portable jack.



"Flight" photograph.

The good lines of the Flamingo may be properly appreciated when it is seen in flight. When this photograph was taken it was being flown by Mr. Geoffrey de Havilland, Junr., the company's chief test pilot.

At the top of the compression leg is a flange which is bolted to the top hinge fitting. This embodies a steel-phosphor bronze bearing which is lubricated by grease gun. At the lower end of the fixed portion of the compression leg is a forked lug picking up the radius rod, the other end of which pivots about a pair of lugs attached to the main spar in the stub wing. The retracting jack picks up at the centre of the radius rod slightly above the knuckle where the radius rod folds. To meet Air Ministry safety requirements a latch is provided to prevent accidental retraction, due to drag or landing loads, in the event of pressure failure in the jacks. The gear is not locked in the up position, oil trapped below the piston of the undercarriage jack providing the necessary support.

In the pilot's cabin is an electric indicator which shows two green lights when the undercarriage is down and the latch is locked; two red lights when the wheels are being drawn up; and no lights at all when they are fully raised. Also incorporated in the circuit is the usual warning horn. This warning also sounds if the engines are throttled back with the undercarriage lock unfastened. To ensure that mud is not thrown up on the lock a special mudguard and wheel scraper is incorporated; the scraper also prevents mud jamming the wheel fork. Towing points are attached to the undercarriage axle caps. The tail wheel is of the Dowty non-retractable type embodying a caster-locking device operated by the pilot through a control in the roof.

The hydraulic system provides a common supply for undercarriage retraction, flaps, brakes, De Havilland Hydromatic airscrews (if fitted) and Sperry automatic pilot. Power is provided by two Pesco gear pumps, one on each engine box. Either one of these pumps can be selected to feed a large hydraulic accumulator, storing 1.75 gallons of special fluid at a pressure of 1,100 lb./sq. in., which is sufficient to enable the undercarriage to be fully retracted in ten seconds and to operate all the services except the automatic pilot. When the hydraulic accumulator becomes fully charged an automatic cut-out comes into operation and allows the pump to idle at zero pressure.

When the pressure in the system drops, the pump is brought into action to restore the supply. In addition to the duplicated engine pump there is an emergency supply of compressed air in the hydraulic accumulator. This has separate pipe-lines and is available for lowering the undercarriage. Additionally there is a stand-by hand pump for use on the ground or in an emergency. This takes its supply through a system which is independent of either engine pump.

The electrical power is provided from two 12 volt 45 ampere-hour batteries in series and charged by two 500 watt generators, one on each engine. Should either generator fail a red light shows on the control panel. The electrical services are:—Engine cooling-gill operating motors; electrically retractable landing lights; navigation lights; cabin, lavatory and luggage compartment lights; a number of electrical indicating instruments in the control cabin; engine starting gear; windscreen wiper; heated pitot-heads; and four sockets (at nose, tail and undercarriage) for use with a plugged-in inspection lamp. The lights in the luggage compartment, incidentally, swifch on automatically when the door is opened.

Should the starter motor fail, the engine may be turned manually to a point just over top dead centre in any cylinder, when by pressing a button on either undercarriage leg the booster coil is actuated, supplying a spark and thereby starting the engine.

The power plant of the 95 consists of two Bristol Perseus XIIc nine-cylinder medium-supercharged, geared sleeve-valve radials. This type of Perseus has a capacity of 24.8 litres; is 52 inches in diameter and is rated at 680-710 h.p. at 2,250 r.p.m. and 4,000ft. The maximum power (available for 5 mins.) is 815 h.p. at 6,000ft. For take-off, 890 h.p. is available at 2,700 r.p.m. The airscrews are normally of the De Havilland three-bladed constant speed type, 12ft. 9in. in diameter, though the new Hydromatics will eventually be specified and will considerably improve the already good one-engine performance.

The Power Units

The engine mounting, which embodies Bristol rubber-in-shear mountings, is of welded steel tube construction and is attached to the wings by quickly removable expanding steel bushes. Each engine unit (including the complete engine on its mounting, with exhaust system and tail pipe, the entire oil system, fireproof bulkhead, and Exactor engine controls) is completely interchangeable with the other. Each engine has a remote gear box upon which is mounted a 500-watt generator, hydraulic pump and vacuum pump. Engine removal is simplified by a special detrick for use in places where overhead tackle is not available. This apparatus fits on top of the wing and can be adjusted for the "tail up" or "tail down" positions of the machine.

The cowling of the Perseus is rather different from standard. The de Havilland Company, in order to improve the performance, take-off and "single-engine ceiling conditions," has departed from the normal type with a ring of gills, and instead of allowing the cooling air to escape around the complete circumference of the engine, has led it down by means of a sloping fireproof bulkhead behind the cylinders to the surface of the wing; here it passes through ducts on each side of the undercarriage, the outlets being situated approximately at mid-chord. The outlet area of these ducts is controllable by gills operated by a Rotax motor. Three positions are provided—open, half open, fully closed. A great advantage, of course, is that as the flow of air over the top surface of the

"Flight" photograph.

This somewhat unusual view of the 95 adequately shows the virtues of the high-wing type from the passengers' point of view. Above the cabin is a remote-controlled D/F loop aerial of the enclosed type, while below the fuselage can be seen the twin heated pitot-heads.

wing is undisturbed, and the lift, therefore, is practically unimpaired.

The wrapper cowl which encircles the cylinder head is in two portions which fix on to the exhaust pipe at the top, and, by means of dead-centre fasteners, are drawn together at the bottom permitting access to the sparking plugs. The other cowlings are quickly removable and held by Dzus fasteners.

Four welded aluminium fuel tanks are mounted in the inboard sections of the wings—two on each side of the fuselage; one, of 89-gal. capacity, is placed in front of the main spar and the second, of 112-gal., is behind the spar. Detachable panels are provided in the top skin of the wing for inspection or removal. There is a selector valve for each engine; this is mounted on the front spar and has four positions:—"off," "supply from front tank," "supply from rear tank," or a cross feed from which each tank is connected to the opposite engine. The fuel passes from this valve to a unit of D.H. design mounted behind each engine on the fireproof bulkhead. This comprises a filter, a non-return valve and a pressure-reducing valve, with connection for the gauge and a low-pressure warning device. The fuel is drawn from the filter by a Bristol duplex pump and returned at 10lb./sq. in. to the pressure-reducing valve, which delivers it at 2½lb./sq. in. The non-return valve is located between the suction and return connections from the pump, and gives a gravity feed to the carburettor when the pump is not running, closing again after the generation of pressure.

On the top rails of each engine mounting is an oil tank of 10½-gal. capacity. Within the tank is the main suction filter, the thermo-pocket and the quick warming oil chamber, consisting of a cylindrical device in the centre of the tanks into which the cold engine oil percolates as soon as the warm oil is used. The oil cooler is mounted on the starboard member of the engine mounting. Cold air is directed from the front of the engine to the oil cooler and is controlled at the exit. A yellow light shows in the cockpit when the oil pressure falls below the minimum limit. The controls and instruments are described and illustrated on pp. 168-169.

Some Contributors to the D.H.95

Aircraftings, Ltd.: fuel cocks. Arrow Switches, Ltd.: switches. Automotive Products, Ltd.: undercarriage airdraulic shock-absorber struts. Aircraft Components, Ltd.: tail wheel units, hydraulic equipment. Amal, Ltd.: oil filters, etc. Avery Equipment Co.: Avery couplings. Bendix, Ltd.: brakes. A. F. Bulgin & Co.: switches. D. H. Bonnella & Sons: lamp holders, etc. Burgess Products, Ltd.: micro switches. British Thomson-Houston Co., Ltd.: generators, charging relay units, solenoid switches. Breeze Corporation: couplings. Birmingham Aluminium Casting Co.: castings. British Ropes, Ltd.: control cables. Birmabright, Ltd.: tubing (aluminium alloy). Bristol Aeroplane Co., Ltd.: engines and accessories. Jas. Booth & Sons: duralumin.

Dunlop Rubber Co., Ltd.: wheels and tyres, de-icing equipment. De Havilland Aircraft Co., Ltd.: Hydromatic airscrews. Exactor Control Co., Ltd.: Exactor throttle control units. Ellison Insulations, Ltd.: Tufnol. General Electric Co., Ltd.: bulbs (cabin, navigation, instrument, landing light, etc.), plugs and sockets, cable. H. M. Hobson (Aircraft & Motor) Components, Ltd.: master-control carburetters. Hughes, Johnson Stampings, Ltd.: forgings. Kelvin, Bottomley & Baird, Ltd.: altimeters, tachometers, synchroscope, compasses. Walter Kidde Co., Ltd.: fire extinguisher equipment. Light Metal Forgings, Ltd.: forgings. A. P. Lundberg & Sons, Ltd.: switches. M.R.C., Ltd.: Teleflex controls. Northern Aluminium Co., Ltd.: castings, Alclad, extrusions. Power Flexible Tubing Co., Ltd.: flexible hoses, tubing. Peto & Radford, Ltd.: accumulators. Plessey Co., Ltd.: Pesco pumps. Reynolds Tube Co., Ltd.: tubing. Rotax, Ltd.: windscreen wipers, landing lights, navigation lights, vacuum pumps, gill motors, starter motor, miscellaneous switches. Rotherham & Sons: cocks. L. A. Rumbold & Co., Ltd.: cabin furnishings. S. Smith's Aircraft Instruments: turn-and-bank indicators. A.S.I., rate-of-climb indicators, time-of-flight clock, gauges, etc.

Skefko Ball Bearing Co., Ltd.: pulleys, ball bearings. Simmonds Aerocessories: lock nuts, floating strips. Superflexit, Ltd.: tubing. Sperry Gyroscope Co., Ltd.: automatic pilots, artificial horizon. Short & Mason, Ltd.: miscellaneous instruments. Serck Radiators, Ltd.: coolers, heaters. Geo. Salter & Co., Ltd.: springs. Triplex Safety Glass Co., Ltd.: Perspex window panels. Tecalemit, Ltd.: oil coolers. Vickers-Armstrong, Ltd.: cocks. Weston Electrical Instrument Co.: selector switches, air and oil temperature indicators, cylinder temperature indicators, voltmeters, resistance bulbs. Wilmot-Breeden, Ltd.: cabin lights, locks, handles.

Among the machine and other tools used in the production of the D.H.95 were the following:

Archdale drilling machines; Brett drop hammer; British Oxygen Co.'s acetylene cutters for jig-making; Broom & Wade squeeze riveter; Consolidated pneumatic riveting guns; Cincinnati press brakes and guillotine (C. Churchill & Co., Ltd.); Dean, Smith & Grace lathes; Desoutter nibblers and drills; Alfred Herbert multiple driller; Leon Huré milling machines (Rudolf Kahn); Jackman portable grinders; Myers riveting clamps; Pollard drilling machines; Henry Pels nibbler; Thiel machine saw (E. H. Jones Machine Tools, Ltd.); Warner & Swasey turret lathes (A. C. Wickman, Ltd.); Wotan shaping machines (Soag Machine Tools Ltd.).

A D.H. Year

AT the company's annual general meeting, Mr. A. S. Butler, the chairman of the De Havilland Aircraft Company, in reviewing the design development progress during 1938, made several statements of general interest. For instance, he said that the Moth Minor was now in quantity production, and that it should be possible for deliveries to start in one or two months. The first six of the production Minors had been reserved as demonstrators for the overseas D.H. companies. The Gipsy Minor engine had, he said, passed its type tests and was also going into large-scale production. The company had had a very large number of enquiries concerning this engine.

During the previous nine months the Airscrew Division had been preparing for the production of the full-feathering constant-speed Hydromatic airscrew, and this type would be fitted to the D.H.95 as soon as it was available. With such a type the full-feathering characteristics would materially increase its single-engined performance. The company's Northern Airscrew Division at Bolton had completed its first full year's working.

Mr. Butler stressed the fact that in due course the whole-time efforts of military aircraft constructors would not be required and a considerable force would then be released in the civil field. He felt that the company had to safeguard its own position by remaining well ahead in civil design and in making a special study of customers' requirements. The 95 should meet a demand for present-day operations.

The company showed a net profit during the year, after reduction of the National Defence Contribution and balance of income tax, of nearly £153,000, as against the figure of £122,000 for the previous year.

FLIGHT AIRCRAFT ENGINEER NEXT WEEK: EMPIRE AIR FORCES NUMBER

HENSHAW'S CAPE DASH

A Brilliant Solo Effort in a Tiny Racing Single-seater

Mr. Alex Henshaw—with the usual cheery countenance.

"Flight" photograph.

TO Alex Henshaw, winner of the 1938 King's Cup Race, goes the credit of having made one of the most spectacular long-distance dashes of recent years—from London to Cape Town and back in 106¼ hours.

Apart from the record aspect, the flight was spectacular in that it was made solo, and in a tiny single-seater racing monoplane. The Mew Gull is not a machine that can be force-landed just anywhere. Trouble of any kind would have meant stepping out by parachute; and the Sahara Desert or the West Coast of Africa is hardly a hospitable place in which to alight by that means.

However, those who know Henshaw know that he is not one to take really silly risks. Last spring, flying in a Vega Gull with his equally enthusiastic father, he surveyed the route and studied the landing grounds. He has confidence in the Mew Gull and in Gipsy engines, born of many hours of full-throttle work in air races, and he knew, too, that he could trust the special modifications made to the machine by Essex Aero, Ltd.

The trial was as much one of human endurance as of mechanical reliability. There, perhaps, Henshaw came nearest failure; even so, his distressed condition at the finish was largely due to a mischance—some nasty cracks on the head caused by bumpy air.

Consistency

Weather conditions, which were not too helpful, were rather similar on both the outward and homeward journeys, and the similarity of his times for the two flights shows how near Henshaw must have been to the theoretical limit for such records. The outward trip of 6,000 miles he accomplished in 1 day 15 hr. 25 min., and the homeward run took 1 day 15 hr. 36 min. The out and home journey, including his rest period of 27 hours at Cape Town, was accomplished in 4 days 10 hr. 1 min.

He thus beats the record set up in November, 1937, by F/O. A. E. Clouston and Mrs. Kirby-Green (flying a D.H. Comet) by 5 hr. 37 min. outward; 17 hr. 47 min. homeward; and 1 day 6 hr. 59 min. for the round trip. The best previous solo time, one way, was that of Miss Amy Johnson in 1936, with 3 days 6 hr. 25 min.

Henshaw's average speed, including all ground stops, but not his stay in Cape Town, worked out at about 152 m.p.h.

To capitulate briefly the log of the flight: Henshaw left Gravesend Airport at 3.25 a.m. on Sunday, February 5, and landed at Oran, Algeria, at 10.30 a.m. the same morning. After refuelling and a short rest he carried on to Gao (French Sudan) and then to Libreville (French Equatorial Africa), which he left at 5.5 a.m. on the Monday. His next stop was at Angola, and he then went straight through to Cape Town, landing at 6.59 p.m. on the Monday.

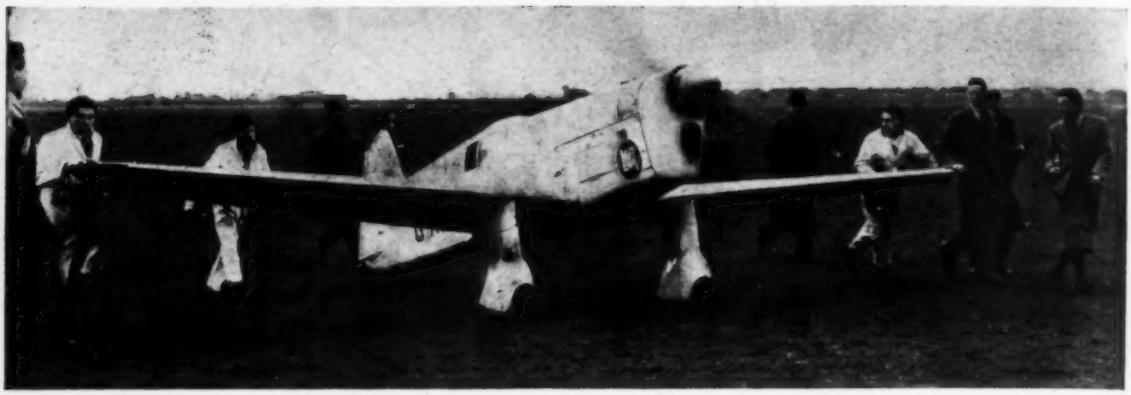
The trip was an uncomfortable one, particularly through rough air conditions on the first stage to Oran. The Mew Gull collected a considerable amount of ice when crossing the Atlas Mountains in North Africa, and very thick weather, with clouds almost down to the ground, was encountered near the Equator.

Henshaw started back at 10.18 p.m. on Tuesday, February 7, and arrived at Mossamedes at 3.45 a.m. the next morning. His second hop was to Libreville, which he left again at 10.40 a.m. the same morning. After a very short rest at Gao he carried on to Oran and got away from there at 7.50 a.m. Thursday. His last hop took him 1,200 miles to Gravesend where, in spite of being in an extremely exhausted condition, he made an excellent landing at 1.51 p.m. the same day.

Although he started with a favourable wind after leaving Cape Town conditions were not helpful for the major part of the flight, and he again encountered ice and cloud when nearing Europe. Bumps were very severe. His Sutton harness had stretched, so that the more severe bumps threw him upwards and brought his head into contact with the low cockpit roof. Already feeling the effects of tropical fever, he suffered considerably by this battering, and his nose bled profusely. He climbed to 18,000 ft. in order to find smoother conditions. In this he succeeded, though, rather naturally, the altitude did nothing to cure the nose bleeding, and Henshaw looked in a pretty bad way when lifted from his machine at Gravesend.

There is very little room in the cockpit of a Mew Gull at

This photograph of the Mew Gull being refuelled at Libreville (French Equatorial Africa) on the outward journey was collected by Mr. Henshaw on the homeward flight and brought back by him to London.



The Mew Gull escorted to the Gravesend tarmac at the end of the great flight. Proud Mr. Henshaw, Senior, can just be seen behind the rudder.

the best of times, and extra equipment which Henshaw was carrying did not improve matters.

The machine, G-AEXF, was the familiar white one with which Henshaw won last year's King's Cup Race, and in which he has competed in a number of events during the last two years. It is by no means new. It had, however, been very considerably modified by Essex Aero, Ltd., specially for this attempt. Whereas it used to have a Gipsy Six R engine, it now had a Gipsy Six Series II. Originally this particular engine was in the prototype Miles Peregrine. W. S. Shackleton, Ltd., had purchased it from Phillips and Powis, and sold it to Henshaw. A. D.H. constant-speed airscrew took the place of the two-position v.p. type which was previously employed.

Increased Tankage

The other main alteration was to the fuel tankage arrangements, with a view to increasing the standard range of 875 miles to 2,000 miles. The main tank capacity was increased by 18 gallons to 87 gallons. A special reserve tank holding 6 gallons was fitted in the cockpit floor, lying between the pilot's legs and curving over the rudder bar. A saddle-type oil tank and cooler, forming the top cowling, were installed above the motor.

In order to comply with French requirements for crossing the Sahara, the Mew Gull carried an emergency wireless transmitter. This, a battery-fed Marconi equipment, was not wired up for air use, but was merely carried in the locker with a view to sending out a distress call in the event of a forced landing.

Essex Aero actually carried out minor and major alterations to almost the whole of the machine, the modifications including the complete engine and instrument installation, alteration of the shape of the cockpit roof, of the spats and of other details. Mr. Jack Cross, managing director of the firm, said that it was possible to measure the amount of oil that had escaped from the installation during the whole flight, and less than 250 c.c. had been lost.

The span of Henshaw's Mew Gull remained at the standard figure of 24ft., and the length 20ft. 3in. The all-up weight had been increased from the standard figure of 2,125 lb. to 2,250 lb.

Sir Kingsley Wood, Secretary of State for the Air, sent Henshaw a message of congratulation on his return.

And now, according to report, Henshaw is planning what may be an even more spectacular record attempt later in the year. The Gravesend stable is busy on an extremely hush-hush twin-engined machine which, it is said, will cruise at 300 m.p.h. and have a range of 3,000 miles. Australia will be the goal and an out-and-home record will be attempted.

Items which played a part in the success of the flight included the following:—

Claudel-Hobson carburetter; Amal flame trap; B.T.H. magnetos, serviced by Euston Ignition Co.; K.L.G. sparking plugs; Callender's cables; Weyburn camshaft; Spencer-Moulton petrol-resisting hose; Superflexit oil tubing; Jubilee hose clips; Shell fuel; Wakefield Castrol oil.

Smith's instruments, including: A.S.I., rev. indicator, altimeter, oil-pressure gauge, time-of-flight clock and Husun P.4 compass; Sperry directional gyro; M.R.C. Teleflex controls; Rotax vacuum pump and switch-box.

Elektron cowlings and instrument panel by F. A. Hughes, Ltd.; fuel tank and cowling materials by the Aluminium Corporation; Duralumin extrusions by James Booth & Co.; Accles & Pollock steel tubing.

Rhodoid windscreen; windscreen moulding by the Hadley Co., Ltd.; Bostik windscreen sealing; Lockheed undercarriage legs; Dunlop tyres; Cellon dope; Venesta plywood; Bessbrook fabric.

Henshaw wore an Irvin back-type parachute and a Rolex watch.

TELLING THE WORLD

"THIS directory fulfils a very useful purpose by providing for potential buyers a means of direct and easy first reference to the firms which make up what has become in the past few years one of our leading industries."

Thus does the Secretary of State for Air, Sir Kingsley Wood, conclude his foreword to the first edition of the directory just issued by the Society of British Aircraft Constructors. Sir Kingsley is slightly inaccurate when he uses the expression "the firms which make up," etc., because the directory does not include, by a very long way, the firms which "make up" the British aircraft industry, but only those which are members of the S.B.A.C. The index discloses the interesting fact that 123 firms are members of the S.B.A.C., and that 67 companies and municipalities are members of the Aerodrome Owners' Association—or 68 including Port Elizabeth City Council, which at present is the only overseas member of the A.O.A.

The directory is divided into three main sections, dealing with aircraft, engines, and accessories, components and materials respectively. The text is repeated in French and Spanish at the back of the directory, and an alphabetical as well as a classified index makes for very easy reference.

Printed in very clear type and well illustrated, the directory should be of considerable propaganda value to the S.B.A.C. and through that to the rest of the aircraft industry.

The directory is quite up to date, and includes descriptions of machines which must have been still on the secret list when it went to press. Generally speaking, the work is informative and accurate, although some of the captions are a bit inept, and the occasional "brick" is dropped. That was, perhaps, inevitable in a first edition. For instance, in the description of the Blackburn Skua the statement is made that the flaps used for limiting the diving speed are "let into troughs forward of the *leading* edge." (The italics are ours.)

The S.B.A.C. directory is not on sale to the public, but arrangements have been made to distribute copies to selected firms, institutions and individuals all over the world.

Mid-week Flying

RECENTLY the Commissioners of the Civil Air Guard appealed to employers to do their best to allow members time during the week for training purposes. Although the cost of flying in the C.A.G. is halved during the week, experience has shown this inducement is not sufficient to ensure full use of all training resources. Mid-week flying is, in fact, at present largely confined to the comparatively leisured, and it follows that members who can least afford it usually have to pay the higher rates.

The main object of this appeal, however, was not to save the members their money, but to give the clubs the best chance of making use of their available machines and instructors.

HERE and THERE

The Scottish Exhibitions

THE two Scottish Aircraft Exhibitions, held primarily with the object of allowing Scottish engineering firms to see the class of work they would be required to undertake on offering themselves as aircraft sub-contractors, are now in full swing at the McLellan Galleries, Glasgow, and the Waverley Market, Edinburgh. They were due to be opened by Sir Kingsley Wood last Monday and Tuesday respectively, and will remain open until Saturday, February 25.

The Air Minister flew to Scotland on Sunday, and was faced with a crowded three-day programme, including visits to Abbotsinch, Leuchars and Turnhouse, the Reserve School at Perth, and the Blackburn factory at Dumbarton, in addition to opening the two exhibitions. He was accompanied by Major J. S. Buchanan, Deputy Director-General of Production, and the Secretary of State for Scotland, Mr. J. Colville, was with him at the opening of the exhibitions.

The exhibitions have been promoted by the Air Ministry in co-operation with the Corporations of Edinburgh and Glasgow Apart from the production aspect, opportunity has been taken to include other features which will be of interest to the general public as well as to potential contractors. For this purpose two examples of modern fighters, the Hawker Hurricane and the Vickers-Supermarine Spitfire, are displayed.

A range of engines is exhibited by Armstrong Siddeley, Bristol, Napier and Rolls-Royce.

Each exhibition includes a section showing R.A.F apprentices under training for various skilled trades, and specimens of their work are exhibited.

There are Air Ministry bureaux at which full information is available as to the exhibits and to the opportunities in the Royal Air Force, its Auxiliaries, and Reserves. The Edinburgh Exhibition has, in addition, an exhibit of Service clothing and a meteorological display covering both Service and Civil flying.

Admission to each exhibition is free. In both cases the public are admitted daily from 12 noon until 10 p.m. A special period, from 10 a.m. to noon, has been reserved each day for the visits of manufacturers, admission being by business card. Air Ministry technical officials are in daily attendance.

The King Inspects Powered Turrets

ON Friday last His Majesty the King paid a private and informal visit to the works of Nash and Thompson, Ltd., at Tolworth, Surrey.

The King had intended to stay only about half an hour, but he was so interested in what he saw that he extended his visit to an hour and a half.

He was received on arrival by Capt. A. Frazer-Nash, Capt. E. Grattan Thompson and Air Marshal Sir Wilfrid Freeman.

The King was greatly impressed with the ease and accuracy of operation of the Nash and Thompson power-driven turrets, and was particularly interested when Mr. C. B. Lowe (a director and chief engineer) wrote His Majesty's name with a pencil placed in the muzzle of one of the guns. The King also signed his name on a parchment, which was received by Miss J. Frazer-Nash, Capt. Frazer-Nash's daughter and principal secretary.

The King recalled that he had seen a prototype Nash and Thompson turret demonstrated at Martlesham in 1936.

During his tour of the factory the King showed particular interest in the jobs of Mr. E. J. Hallett, of the drawing-office staff, and Mr. B. Seager, in charge of a special jig-boring machine.

A Film Worth Seeing

IF anybody wants relief from the all-shouting, all-faking, all-sobstuff kind of million-dollar production which is too often passed off as a flying film, he should make a point of seeing an unassuming little picture called *Prelude to Flight*.

It would probably come under that unsatisfactory and misleading heading of "documentary" film. Made by Messrs. D'arcy Cartwright, A.R.P.S., and Graham Tharp, of the Shell film unit, with Mr. Geoffrey Bell as technical adviser, it has gliding and soaring as its subject.

Most of the picture was made at Dunstable, with members of the London Gliding Club as "actors"—only since they are merely seen doing what they do there every week-end, and doing it with complete unselfconsciousness, we have an effect of commendable realism, translated into sheer beauty by the composition and lighting of every shot.

A pupil is seen listening to his instructor, and [illegible] is so phrased that it will be comprehensible to the average audience without sounding silly to the initiated—no mean feat, this, and one that is achieved throughout.

The film then takes us through the various stages of instruction, until finally we accompany a practised pilot—played by Mr. Hugh Bergel—on a soaring flight in a thermal current. More clever work here; he describes his progress skyward as though thinking aloud, and his voice is heard against a background of gently whispering airstream, while terrestial noises—dogs barking, factory hooters—float upward from the receding patchwork. No one will imagine that sound-recording apparatus was actually carried in the sailplane, but the effect is perfect.

Prelude to Flight—which runs about 15 minutes—finishes with some superb but all-too-short cloud impressions.

Gliding clubs should persuade their local cinemas (if cinemas *can* be persuaded) to book the film, which will appear in a week or two at the Regal, Marble Arch. Technique Distributors, Ltd., are handling it.

Mr. Kronfeld on Gliding

MR. ROBERT KRONFELD, who is now instructor-manager of the Oxford University and City Gliding Club, gave a lecture on "Gliding and Soaring" at the Royal Society of Arts on Wednesday of last week.

Illustrated with slides and films, the lecture was an extremely informative exposition of the whole subject. It seemed to be primarily intended for the uninitiated, but the amount of laughter at the mention of such things as the characteristics of primary trainers showed how large a proportion of the audience actually consisted of the very much initiated.

Discussing the various methods of launching, Mr. Kronfeld described in some detail the flat-field winch launching method used by the Oxford Club. Pupils start *ab initio* on the cable, and the expert winch driver has them under full control. If a pupil, told to keep within three feet of the ground, goes too high or over-corrects he can be safely brought to earth immediately. Over 4,000 launches were made last summer, and with negligible damage to the gliders.

The horizon bar, originally fitted to the power-driven Kronfeld trainers, was being successfully used on gliders at Oxford. One of the chief difficulties of the gliding pupil, like any other flying novice, was to keep his machine in a more or less horizontal position, but with the horizon bar in front of him this difficulty disappeared, and after a number of flights he could dispense with it and fly by the feel of the machine alone.

After describing some of his own pioneer soaring flights (and he has a really remarkable record of achievement) Mr. Kronfeld related some of the more hectic adventures of Continental sailplane pilots. Two Germans, for instance, in a two-seater sailplane, had ascended in a thunderstorm and found themselves in such a violent up-current—of the order of 75ft./sec.—in the centre of the cloud that they were carried to over 20,000 feet. They were without oxygen and began to feel extreme discomfort. It was impossible to dive the machine against the up-current without reaching a speed dangerous to the structure, and it was impossible to leave the cloud horizontally since there was violent turbulence in its fringes, which would have had a similar disastrous effect. Their only alternative was to escape by parachute, and this they did; even then their adventure was not finished, because they were still in the up-current when their parachutes opened, and they were held suspended in the cloud for an uncomfortable length of time.

Mr. Kronfeld concluded with a plea for a more generous subsidy for the gliding movement, pointing out that the present £5,000 was less than the cost of one fighting aeroplane.

An excellent cine film by Mr. Philip Wills ended the evening.

His Master's Buzzer

MOST of us regard morse and radiograms, in association, as an unmitigated nuisance, but an enterprising signals instructor to the R.A.F.N.R. has effected a happy union. Mr. C. E. Masters, late of the Marconi Company, has found his work facilitated by teaching his pupils morse-code reception by means of gramophone discs which he has recorded.

He has had a number of records made, giving various messages and reception speeds from 4 to 11 and 12 to 20 words per minute. These records, which are 10in. double-sided, are available at 2s. 6d., and full details may be obtained from Mr. Masters at Orchard House, Finchampstead Road, Wokingham.

CORRESPONDENCE

The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

CELESTIAL NAVIGATION

A Pupil's View

I HAVE just read Mr. Chichester's article on navigation in *Flight* of January 19.

Having started my training as a direct-entry air observer only last November, I cannot be qualified to express opinions, but I am glad to see that one with so much experience as Mr. Chichester bears out a theory that I have held since the beginning of my course, namely, that celestial navigation should be included in the syllabus from the very commencement of the course.

If we were merely taught the use of a sextant it would be something to start with. After all, the more methods one has of obtaining position lines the more accurate one's navigation can become. The navigator has what seems to me to be the most interesting job of all in flying modern aircraft, and I am exceedingly glad I got in under the direct-entry system. OBSERVER.

LIGHTER EQUIPMENT FOR THE CLUBS

A Reader is Hopeful

I AM writing, as an ordinary working young man, to say how good it was to read that Taylorcraft aeroplanes are to be made in this country, and I hope that now we shall have some *really light plane* clubs, where such machines can be hired *really cheaply*. A friend of mine just back from Canada has toured this country, but failed to find a club using light modern aircraft; all of them were using—to quote Mr. H. R. Dimock—the old box-kite type with weak legs, many being ten years old.

Now, whose fault is it that light machines have not progressed in this country, as they have in America? It is due to the clubs, on the advice of their instructors, who are usually ex-R.A.F. or have learned to fly "big stuff" at expensive high-brow clubs, and therefore they "snob" the light stuff, having no knowledge of it. STILL HOPING.

Welwyn Garden City.

AVERAGING SEXTANT OBSERVATIONS

A Simple Method

WITH the increased range of modern aircraft, astronomical navigation is becoming more and more popular among both civil and Service navigators. As speed and ease of calculation are necessities in utilising astronomical observations made during high-speed flight, numerous books of tables and "short methods" have been produced and published, and the mathematics involved in the reduction of a line of position is now so simple that only a very short time is required to convert the observations into a position on the chart.

Without a doubt the most lengthy part of the problem is the selection of an average observed altitude and G.M.T. with which to commence the calculations, and very often it is during this stage of the proceedings that errors occur, especially if the observer is cold and tired, or particularly flurried, at the time.

The following method of selecting an average altitude and G.M.T. has been successfully used by myself and several of my fellow-navigators for nearly two years and it has never yet resulted in a large error in position. Its quickness and simplicity make it worthy of a trial by every navigator who is keen on obtaining good results from his sights.

I have discovered that, under average conditions, the experienced observer takes his series of sights at fairly regular intervals of time, say, every ten or twenty seconds, and as few seconds error makes very little difference to the resulting position line (except, perhaps, in regions near the equator) or when the body is near the prime vertical, it is safe enough to observe the time of the middle sight of the series, assuming the latter is made up of an odd number, viz., three, five, seven, etc., when the sight to be timed becomes the second, third or fourth, etc.

Due to bumpiness of the air and vibration of the aircraft, the series of observed altitudes may, however, present an irregular array of figures, and the usual way of selecting an average is by arithmetic, a rather lengthy procedure if the figures are at all inconvenient.

A far simpler and speedier method is to select that observation usually termed the "median" of the series. This is achieved by disposing of the observations in the mathematical ascending order, until the "middle highest" observation is reached, which is the "median." This will be the third highest in five, or the fourth highest in seven, etc. Note that the series must always be an odd number of sights.

The following examples will clarify the procedure:—

35	27′	second	52	09′	second
35	23	least	52	01	least
35	36	median	52	18	
			52	25	
35	32	third	52	13	median
35	48				
35	51		52	11	third
35	37		52	22	
35	36′	3 Arithmetical average	52	13′	

A few trial examples of this method will firmly convince the experimenter that the results are quite genuine, even in the worst cases where differences of altitude are considerable.

The method has another important advantage, viz., should one or two of the observations be really bad ones their error is not included in the averaging, for it invariably takes that particular sight, or sights, clear of the "median," whereas the error will be included in the arithmetical method, thus resulting in a considerable error in position.

Should the "median" also be the middle observation, the time of which was recorded, and the altitudes are in their correct order of mathematical ascendency, the navigator can be quite confident that his series of sights is a good one, and that the position resulting can be relied upon to be reasonably accurate. This is something that is rather important when the D.R. position is very doubtful and one is hoping to make a landfall after a long ocean flight.

King's Lynn. W. G. EASTON, C.A.N.L. (First Class).

ASKING THE AIRLINE PILOT

The G.A.P.A.N. Replies to "Indicator"

IN the issue of *Flight* dated January 26, 1939, an article appeared, under the heading "Topics of the Day," by "Indicator," which contained the following erroneous and extremely *ex parte* statement:—

> "In this country, at any rate, the average transport pilot is left almost entirely in the dark until he is told to go along to such-and-such aerodrome and be passed off on to some new type which has been purchased. This is where the G.A.P.A.N. should have stepped in and where the newer B.A.L.P.A. is attempting to make radical changes."

The Guild has always welcomed, but received little, honest and constructive criticism. A critic should be sure of his facts before making a loose and inaccurate statement such as the above in the technical Press. Such tactics can only be described as hitting below the belt, for "Indicator" would have been given chapter and verse, as far as the Guild was concerned, had he troubled to lift the telephone receiver and dial Central 0148.

Briefly, the facts are as follows:—

As far back as June, 1936, the Guild fought a bitter battle in the House of Commons through its late Master, Captain Freddie Guest, during the hearing of the Air Navigation Bill, which was to empower the Secretary of State to delegate to a body substantially representative of the interests concerned with civil aviation, questions of airworthiness. After the passing of the Bill this body was known as the Air Registration Board.

When the Guild took up the cudgels in Parliament no commercial pilot appeared on the list of persons from whom it was proposed to select the new members of the Board.

The Guild pointed out that the airline pilot and instructor have, each in his own sphere, accumulated a wealth of practical experience of which it would be little short of idiocy not to make use. Both have definite views on such matters as cockpit design, the convenience and situation of instruments and controls, fore and aft view and manœuvrability of aircraft on the ground and in the air. The airline commander, whose responsibility tends to grow daily greater as the speed of aircraft increases, was entitled to direct representation upon such subjects.

It was suggested that the aircraft operators and manufacturers on the Board could express the point of view of the pilots. The Guild strongly opposed this suggestion and pointed

Correspondence (Continued)

out that insurers are accustomed to rely on the judgment of experienced pilots at every turn in assessing risks and that the Air Ministry itself relies on the reports of pilots in deciding whether to licence pilots or aerodromes.

The Guild emphasised the point that the judgment and skill of the "B" licence pilot is the substratum upon which the whole operation of commercial aircraft rests.

By constantly hammering home these points through its friends in the House, the Guild obtained an amendment that the Board should be so constituted as to include among its members an independent "B" licence pilot who had not had less than five years' professional experience as a pilot of aircraft.

That person, chosen by the Secretary of State, was Captain Rex Stocken, who is in constant touch with all classes of pilots. To-day, as Deputy Master of the Guild, he receives at first hand the views of the airline pilots, instructors and test pilots who constitute the Court.

Since its inception the Air Registration Board has co-operated with the Guild and has at all times shown a keen desire to obtain the opinion of the commercial pilot on all matters likely to affect him, as letters in this office will fully bear out.

On March 10, 1938, the Guild wrote to the Air Registration Board putting forward concrete proposals for an independent test pilot or test pilots to be employed by the Board and an alternative proposal in which it offered to supply a list of suitable experienced and independent pilots on whom the Board could call from time to time.

That is the evidence of the "G.A.P.A.N. stepping in." Had the Guild not "stepped in" as far back as 1936, the commercial pilot would have had no direct representation on the Air Registration Board whatsoever.

It is, of course, obvious that aircraft manufacturers and operating companies would do well to call into consultation senior airline pilots when a new type is being ordered. This should be done from the design stage. The designer has his ideas of the aerodynamic possibilities of the type he is creating but the pilot would also be able to advise him as to the probable effect such possibilities or innovations would be likely to have on the control and manœuvrability of the aircraft. We have also advocated for years that airline pilots should be given an opportunity of making a thorough inspection of the mock-ups of new types. This was done in the case of the Short Empire class flying boats, when several senior pilots of Imperial Airways were sent to Rochester to inspect the mock-up. It is worthy of note that this class came straight off the stocks, passed their tests, went straight into quantity production and have since gained an international reputation for reliability and comfort.

One of our members, a master pilot, is of the opinion that much of the trouble which has recently caused civil aircraft to be temporarily withdrawn for modification could have been eliminated before issue had pilots been consulted during the design and mock-up stages.

We also consider that before a new type is put into quantity production or service it should be flown at least 100 *hours in all weathers*, with a full dead-weight load, *over the route or routes on which it is destined to serve*.

Finally, "Indicator's" paragraph-heading, "Ask the Airline Pilot," has been the slogan of the Guild since 1929. The result of ten years' hard work with that object in view is that the airline pilot is now consulted on most things affecting his livelihood. The Air Ministry, particularly, realise the value of consulting him. Only last month one of our members, an airline pilot (B.Sc.Eng.) was called into consultation with Air Ministry officials to state the Guild's views on approach and landing facilities at Croydon during bad weather. Another Air Ministry committee, at present considering modification to pilots' licences, has five airline pilots among its members.

Pilots themselves decide who is competent to instruct in the art of flying and the Air Ministry accepts their decision.

We think the time is not far distant when the manufacturer and operator will, for their own sakes, consult the qualified airline pilot. It seems to us to be a matter for co-operation between the two, with the production of safe, speedy and comfortable aircraft as their goal. LAWRENCE A. WINGFIELD,
London, E.C.1. Clerk, The Guild of Air Pilots And Air Navigators.

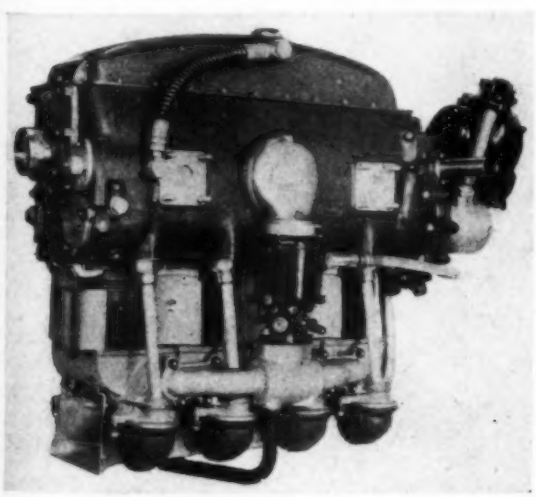
["Indicator" comments on this letter in his "Topics of the Day" elsewhere in this issue.—ED.]

A GERMAN 50 h.p. UNIT

FOR some years the Zündapp Company of Nüremburg has been engaged in developing a small aircraft engine. Official tests have now been completed and the unit is in production.

The new engine has four steel cylinder barrels, heavily finned and each secured to the light-metal crankcase by four bolts passing through the main bearing caps. The bore is 85 mm. and the stroke of the light-alloy pistons, which carry three compression and (above the gudgeon pin) one oil scraper ring, is 88 mm., giving a total displacement of 1.98 litres. The compression ratio is 6.2:1.

A one-piece crankcase is used; the crankshaft is supported in five divided needle bearings such as are also employed for the big ends. The steel connecting rods are of H section; the gudgeon pins float; and the airscrew hub is of the Hirth type.



The 50 h.p. Zündapp.

Cylinder heads are of light alloy and have a semi-spherical combustion chamber and radially disposed valves, which are operated via push-rods and rockers (on needle bearings) from two camshafts supported in roller bearings on each side of the crankshaft.

A Pallas down-draught carburetter is fitted on the left side of the engine. The induction pipe is provided with a heating chamber at the point where the pipe from the carburetter joins the horizontal manifold. Part of the exhaust gas is conducted through this chamber. Sparking plugs are arranged in the centre of the cylinder heads. A Bosch magneto is mounted at the rear of the engine, being driven by a flexible coupling.

Data are: Normal output, 50 h.p. at 2,300 r.p.m.; maximum output, 55 h.p. at 2,550 r.p.m.; fuel consumption, 0.48 to 0.53 lb./h.p./hr.; length, 800 mm.; width, 350 mm.; height; 650 mm.; and weight, complete with air-cooling chute, 132 lb.

"Pou" Redivivus?

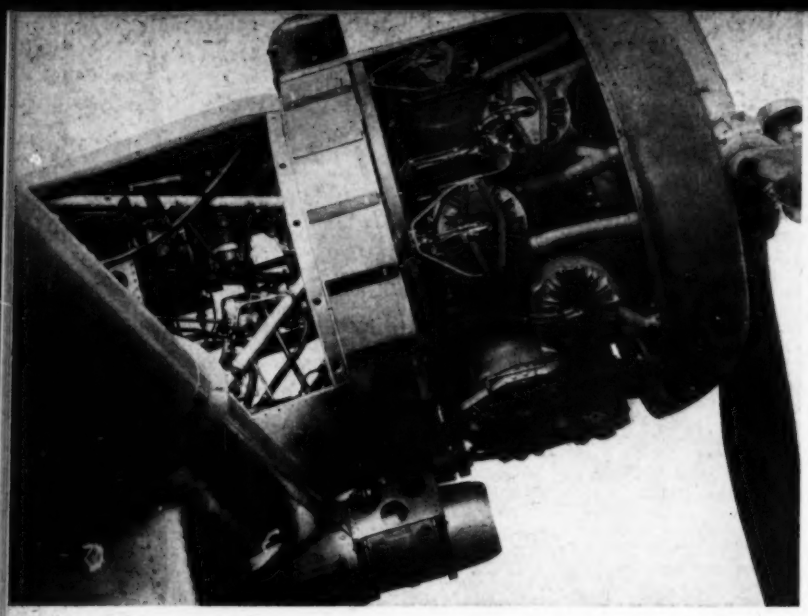
THE first production model of the Mignet H.M. 210, the prototype of which was exhibited at the last Paris Aero Show, made its test flights recently. Powered by a 70 h.p. four-cylinder Minié engine, the machine left the ground in 30 metres. At 600 metres from standing start it was at a height of 175 metres. This was with pilot only. When carrying a passenger the unstick run was 40 metres and the height, 600 metres from the start, was 140 metres.

The machine was found to be perfectly stable longitudinally and directionally, although it naturally rolled laterally in the gusts; but the nose remained on the horizon. The machine will fly level at 30 m.p.h. on approximately half-power and cruises comfortably at 96 m.p.h. On full throttle the speed seems to be 106 m.p.h., but the machine then climbs rather slowly.

The H.M. 210 is being marketed at 55,000 francs (approximately £310 at the present rate of exchange).

Design of a Factory

THE architects responsible for the new Cunliffe-Owen aircraft factory at Southampton Airport—the opening of which was described in *Flight* of February 2—were W. H. Saunders and Son, of Southampton.



Installation of the Bristol Hercules in the Northrop monoplane used by the Bristol company for flight-testing. The accessories are driven from a gear box behind the engine bulkhead.

THERE was a record attendance at the lecture given by Mr. A. H. R. Fedden to the Royal Aeronautical Society and the Institution of Automobile Engineers on February 6, and a large portion of the audience had to be accommodated in another room, there to listen to Mr. Fedden via loudspeakers. For their benefit the slides and the slow-motion film were projected at a second "sitting" following the lecture itself and the discussion. Mr. Percy C. Kidner, president of the I.A.E., was in the chair. We give, in the following pages, a precis of Mr. Fedden's paper and the discussion which followed it.

SLEEVE-VALVE DEVELOPMENT

The Story of the Successful Work of the Bristol Company : Mr. A. H. R. Fedden's R.Ae.S. and I.A.E. Paper

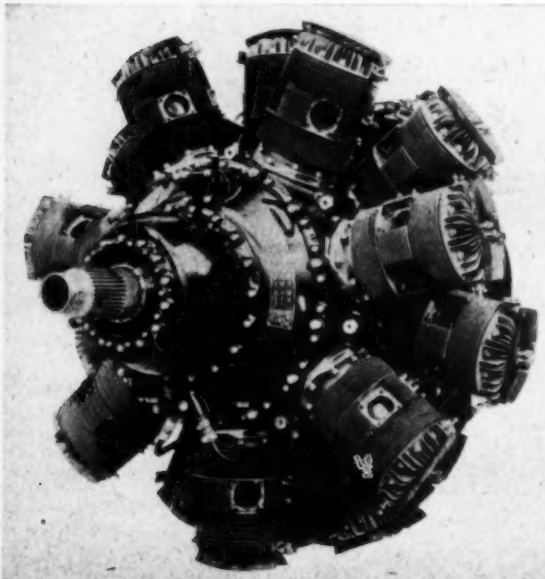
Mr. A. H. R. Fedden, chief engineer (engine dept.) of the Bristol Aeroplane Co., and author of the paper.

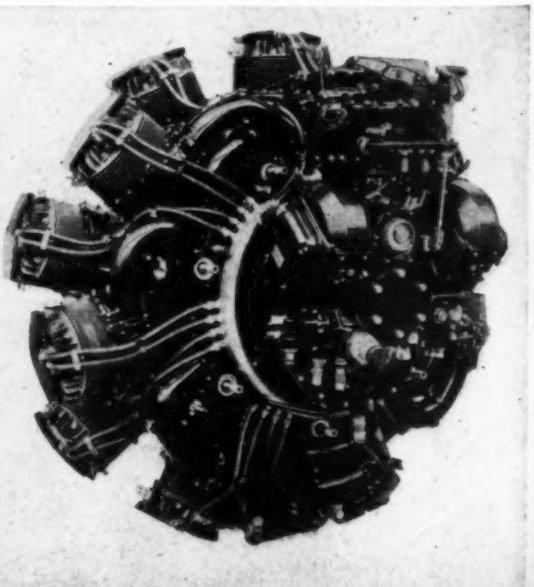
MR. FEDDEN began his paper by outlining under five heads the main drawbacks of poppet valves, and said that conservatism and lack of initiative and financial backing had delayed the introduction of the sleeve valve, which had the obvious advantage of positive control and regular motion.

In his historical review, Mr. Fedden recalled that to Mr. Charles Y. Knight, of Chicago, must be given the honour of developing the first sleeve-valve engine—in 1905. He recalled that the Knight engine, with two sleeves, used reciprocating motion only. The discovery of the single sleeve which is given a combined translatory and rotary motion was discovered simultaneously and independently by two inventors in 1909 : the Scottish engineer, Peter Burt, and the Canadian engineer, Charles McCallom. The first sleeve-valve aero engine of the Burt-McCallom type was produced in 1913-14 by the Argyll Co. for the Aero Engine Competition organised by the British Government in 1914. It was an in-line water-cooled six-cylinder engine of 785 cu. in. and produced a maximum of about 130 b.h.p The war caused the development work to be shelved and the only research work on sleeve valves during the war was an experimental adaptation of a twelve-cylinder vee engine of 140 b.h.p. produced by the Royal Aircraft Factory.

Interest in the single-sleeve engine did not revive until 1925, when the Continental Motors Corporation, of Detroit, acquired the Burt-McCallom patents. The firm exhibited a single-sleeve-valve engine in 1927. It was of the nine-cylinder type, of 787 cu. in. capacity and developed 220 b.h.p.

(Below) Two views of the Bristol Taurus engine, of 1,065 max. b.h.p.





An early Aquila engine was installed in a Vickers Venom fighter.

The A.R.C. Report of 1925-26 referred in warm terms to experimental work on the sleeve valve carried out by Mr. H. C. Ricardo and stimulated interest in the British aero engine industry.

The Bristol Aeroplane Co. entered the sleeve-valve picture in 1926 and had, Mr. Fedden said, so far performed the feat of remaining there. The present position was that the Perseus sleeve-valve engine had been in production for some months; the Taurus and Hercules were about to go into large-scale production at Bristol; and other engines were being developed by the same firm, while reports were frequently made that sleeve valves were being investigated by a number of aero engine firms and research institutions at home and abroad.

In 1926 the Bristol Co. foresaw that a 1,000 h.p. single-row radial engine would shortly be required. It was considered that the optimum cylinder size would be over 5in. diameter and that a four-valve air-cooled cylinder with open rocker gear and compensated push-rod mechanism was the only suitable scheme. The cuff-type, rotary, two-sleeve and single-sleeve valves were all carefully considered. The rotary valve was excluded because of its operating mechanism and difficult lubrication. The cuff valve was also difficult to lubricate and suffered from limitations of port area and combustion chamber design. The limitations of the two-sleeve valve were known and it was considered that the type had no future. The much simpler single-sleeve valve was, however, very attractive, although the only data available were some results of preliminary tests undertaken by Mr. Ricardo and the promising Barr and Stroud motor cycle engine. After several months of preliminary investigation the conclusion was reached that the Burt-McCallom valve gear presented the greatest possibilities and it was decided to institute an extensive research programme.

Taking a Chance

There was considerable risk in undertaking such a programme as it was fully realised that several years would be lost if it should prove that the promises of the original investigations were not fulfilled. The development work was greatly assisted by the technical encouragement and financial assistance given by the Air Ministry, without whose help it was problematical whether the difficulties encountered and many early setbacks could have been overcome.

The first Bristol single-sleeve unit was constructed and run towards the end of 1927 during one of the recurring periods when the in-line air-cooled engine came into the picture. The intention was to design an inverted twelve-cylinder engine, and the test unit took the form of the vee twin so as to simulate a cylinder pair of this engine. The bore and stroke were 5¾in. by 6in. During 1928 considerable experience was obtained with this unit, which obtained a b.m.e.p. of 135lb./sq. in. at 2,000 r.p.m. The nickel cast-iron sleeves were unable to withstand the high pressure when masking the ports during the explosion stroke. Attempts to use steel cylinder barrels with semi-steel sleeves were not successful, due to high local temperatures. The test indicated that the major problems were the cylinder-head cooling and the sleeve-valve material.

The unit was rebuilt in 1930 with forged K.E.965 steel sleeves, aluminium alloy barrels and heads and increased finning. One of the sleeves was run in the soft condition, the other was nitrided. The soft sleeve was unsatisfactory, but the nitrided sleeve gave promising results. A reduction of 50 degrees C. in head temperature was obtained by improved design. A b.m.e.p. of 145 lb./sq. in. at 2,000 r.p.m. was obtained. By March, 1931, it had become possible to complete 100 hours endurance test without strip or adjustment at 2,000 r.p.m. and 120 lb./sq in. b.m.e.p. The success of this test was the real turning-point in sleeve-valve development.

Work was begun in 1933 on a 5in. by 5¾in. cylinder intended for a 350 b.h.p. civil engine. The powers obtained on this cylinder were so promising that when the nine-cylinder engine, subsequently known as the Aquila I, was type-tested in 1934 it was for a maximum of 500 b.h.p.

Research work on poppet valves proceeded parallel with that on sleeve valves, and work on a cylinder of the same power but with two poppet valves and overhead camshafts made some interesting comparisons possible. The design of the poppet-valve engine was not proceeded with because it was considered to have been rendered obsolete by the development of the sleeve valve.

Mr. Fedden pointed out that up to the present time some 35,000 hours had been run on single-cylinder single sleeve-valve research. Performance of cylinders of Perseus size could best be gauged by comparison with that of the Bristol Mercury, a four-valve poppet type of the same bore and stroke. Data for single-cylinder units of the Perseus and Mercury types are given in Table I:—

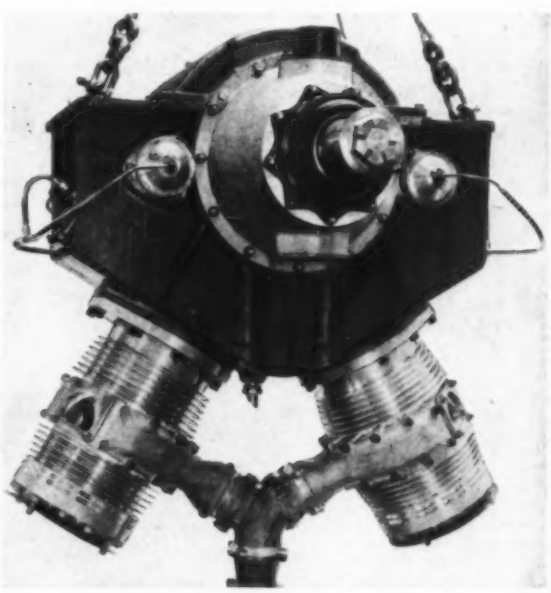
TABLE I.
Comparative Data of Bristol Cylinders.

	Perseus	Mercury
Cylinder type	Sleeve	4 poppet push rod
Valving	5¾ × 6½	5¾ × 6½
Bore and stroke, in.	168.8	168.8
Displacement, cu. in.	42.1	46
Cylinder assembly weight, lb. ...	2,970	2,364
Cooling fin area, sq. in.		
Sustained peak power naturally aspirated 87-octane fuel :		
B.m.e.p., lb./sq. in....	138	130
R.p.m.	3,200	3,000
B.h.p./sq. in. piston area	3.62	3.20
Mean pistou speed, ft./min. ...	3,460	3,250
Sustained power for 100 hours 100-octane fuel :		
B.m.e.p., lb./sq. in.	220	185
R.p.m.	2,800	2,750
B.h.p./sq. in. piston area	5.05	4.18
Mean piston speed, ft./min. ...	3,040	2,980

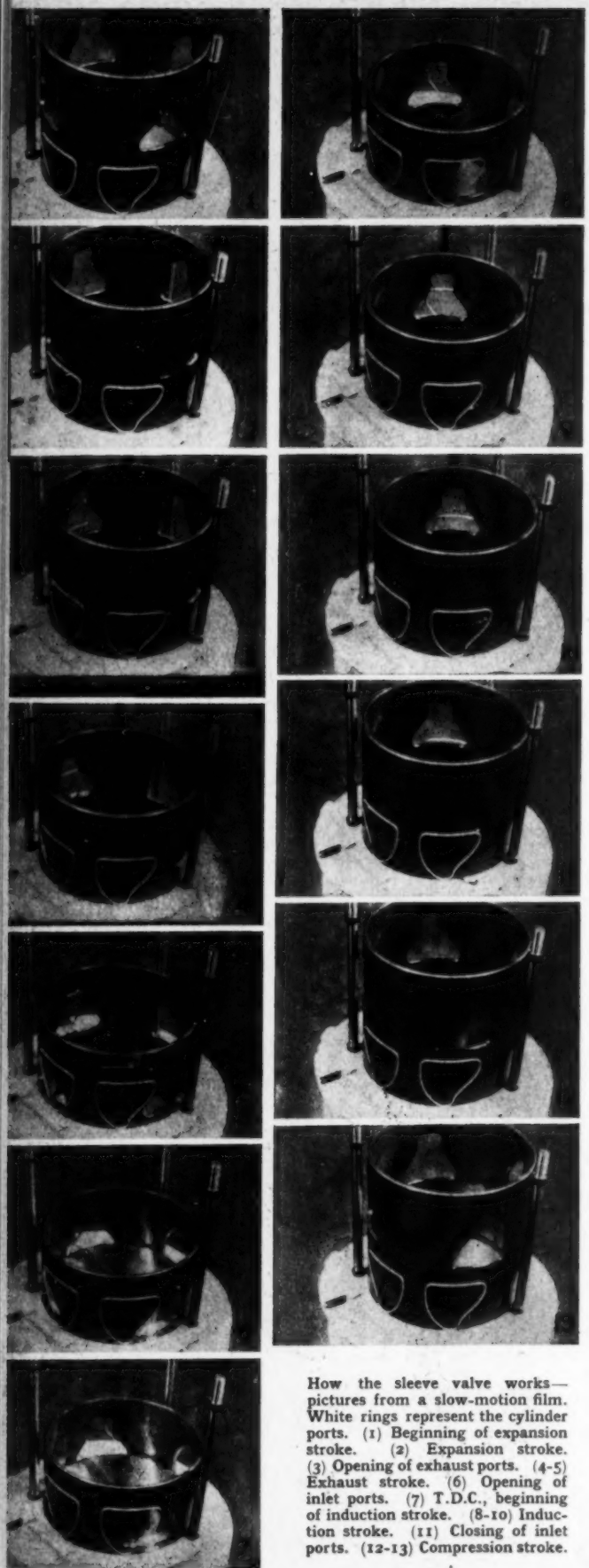
The power quoted can be maintained during 100 hours without distress.

A feature of all the sleeve-valve units and engines tested by the Bristol Co. had been the remarkably stable shape of the fuel consumption loops, and the lecturer pointed out that the smoothness of running under extreme economy conditions was as satisfactory on the main engine as on the single-cylinder units.

Mr. Fedden then made a comparison between the Aquila cylinder and the poppet-valve cylinder of 5in. bore referred to previously. The data are given in Table II.



The first Bristol sleeve-valve test unit was an inverted twin.



How the sleeve valve works—pictures from a slow-motion film. White rings represent the cylinder ports. (1) Beginning of expansion stroke. (2) Expansion stroke. (3) Opening of exhaust ports. (4-5) Exhaust stroke. (6) Opening of inlet ports. (7) T.D.C., beginning of induction stroke. (8-10) Induction stroke. (11) Closing of inlet ports. (12-13) Compression stroke.

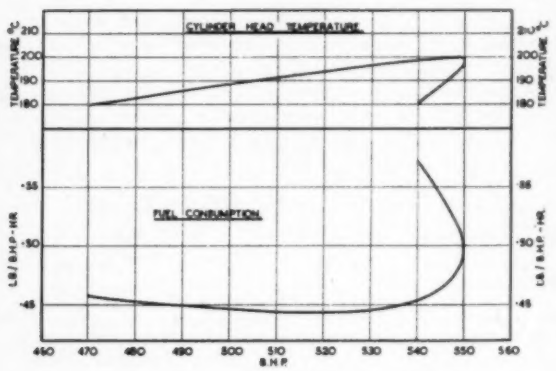
TABLE II.

Comparative Data of Sleeve and Poppet-Valve Cylinders.

	SLEEVE	2 POPPET OVERHEAD CAMSHAFT
Cylinder type and valving	5 × 5½	5 × 5
Bore and stroke, in.	105.5	98.2
Displacement, cu. in.	31.5	42.8 with double camshaft 44.2 with single camshaft
Cylinder assembly weight, lb. ...	1,920	1,660
Cooling fin area, sq. in.		
Sustained peak power naturally aspirated 87-octane fuel :		
B.m.e.p., lb./sq. in.	138	121
R.p.m.	3,600	3,300
B.h.p./sq. in. piston area... ...	3.37	2.525
Mean piston speed, ft./min. ...	3,220	2,750
Sustained power for 100 hours 100-octane fuel :		
B.m.e.p., lb./sq. in.	240	
R.p.m.	3,300	No development on 100 octane fuel
B.h.p./sq. in. piston area... ...	5.36	
Mean piston speed, ft./min. ...	2,980	

He pointed out that it should be remembered when analysing the above performance figures that the sleeve valve was still a relatively new device.

As an indication that interesting developments might be expected, Mr. Fedden instanced a recent test designed to discover the limit of output of a sleeve-valve unit. The test was inconclusive because the limit proved unattainable with the supercharger available, but the results were, nevertheless, outstanding. With a boost of 14 lb./sq. in. and a cylinder of 168.8 cu. in. capacity, the b.m.e.p. obtained was 305 lb./sq. in. at 2,400 r.p.m. and 272 lb./sq. in. at 3,000 r.p.m. The corresponding powers per unit of piston area were 6.0 b.h.p./sq. in. and 6.7 b.h.p./sq. in. respectively. If the above figures were correct for the power absorbed by the separately driven blower, the b.m.e.p. was 276 lb./sq. in. at 2,400 r.p.m. and 245 lb./sq. in. at 3,000 r.p.m., while the powers per unit of piston area were 5.4 b.h.p./sq. in. and 6.0 b.h.p./



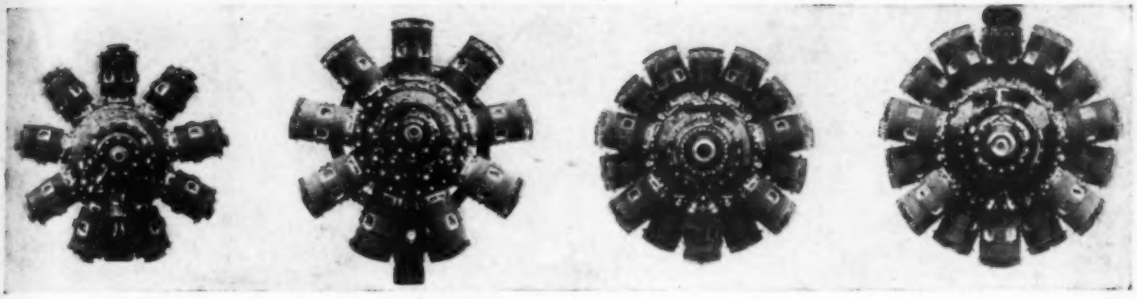
Fuel consumption loop of the Perseus X at 2,400 r.p.m.

sq. in. respectively. Mr. Fedden thought that the powers obtained could not be approached with a poppet-valve unit under similar conditions.

He concluded from this test that the main obstacles to the immediate adoption of greatly increased ratings for sleeve-valve engines were the mechanical and lubrication difficulties in converting the gas pressure to a tangential force and the next move appeared to lie not so much with the designer as with the metallurgist and lubrication specialist.

Mr. Fedden explained that the cylinder of the Bristol sleeve-valve engines has two exhaust ports in front and three inlet ports at the rear. The sleeve has only four ports, one of which uncovers alternately an exhaust and an inlet port in the cylinder. The sleeve is provided with a spherically seated bearing, which can swivel so as to remain in line with the pin of a small crank. The drive is performed by the rotation and sliding motion of the pin in the bearing and by the swivelling motion of the latter in its housing. The small cranks are driven by a train of gears inside the front cover.

Extensive research on cooling was carried out and led to satisfactory performance. The first big advance was made in 1930, when the cylinder head was provided with a fin arrangement which incorporated a baffle directing the air over the crown of the head and producing turbulent circulation around the sparking plugs. The 1930 general layout had been retained ever since and had been developed to the present form with radial finning, giving circularity under running conditions together with cooling adequate for all power outputs attained so far. The present head was a die-casting in Y-alloy. It was interesting to note that the 1930 type of head might be regarded as the forerunner of complete pressure baffling



		Aquila	Perseus XII	Taurus	Hercules II
Displacement	(litres)	15.6	24.9	—	38.7
"	(cu. in.)	950	1,520	—	2,360
Take-off	(b.h.p.)	710	830	1,010	1,300
Max. ..	(b.h.p.)	725	905	1,065	1,375
Weight	(lb.)	795	1,105	1,280	1,050

The four Bristol sleeve-valve engines compared. The views are to the same scale so that they give an idea of relative size.

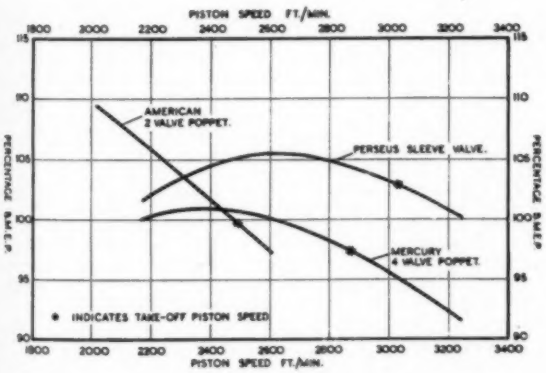
because the whole layout was based on attaining a velocity head at the upper front section and allowing the air to leak through finned cells to the lower-pressure air of the rear.

Development on sleeves had also taken place, and, in addition to the use of nitriding, increased port area had been provided and control of swirl obtained. The piston, also, had been subjected to many thousand hours of work. It is a light alloy drop forging with two compression rings and two scraper rings.

Of the standard driving ball assembly used in the Bristol sleeve-valve engines, Mr. Fedden said that this had been absolutely reliable. A test rig was employed to facilitate investigations over long running periods under arduous conditions. The success of the present engine was a result of the considerable design and research efforts. Fortunately, the drive assembly adopted had proved to be the simplest of those tried. On the test rig it had been found possible to transmit more than 4 h.p. through the sleeve drive. As a result of suitable detail design, an appropriate selection of materials, and the nature of the motion, wear had been almost eliminated from the production series of sleeve drive.

Main Engine Development

Mr. Fedden proceeded to review the various types of Bristol sleeve-valve engine. Designs for a complete engine were put in hand after four years of single- and two-cylinder research. In 1932 the Perseus I, a nine-cylinder radial, was type-tested at 515 b.h.p. normal rating and 638 b.h.p. maximum. This


PISTON SPEED FT./MIN.
1800 2000 2200 2400 2600 2800 3000 3200 3400
AMERICAN 2 VALVE POPPET.
PERSEUS SLEEVE VALVE.
MERCURY 4 VALVE POPPET.
* INDICATES TAKE-OFF PISTON SPEED
PERCENTAGE B.M.E.P.

Comparative breathing efficiencies of two-valve, four-valve and sleeve-valve cylinders.

was subsequently increased to 700 b.h.p. and the engine endurance-tested in a Bulldog. It appeared in public at the Royal Air Force Display of 1934.

Due to an incomplete understanding of the fundamental problems involved when the rating was increased, considerable setbacks were encountered during the development of the slightly modified Perseus II, but the engine was finally type-tested in 1934 and submitted to a 250 hours' cruising test at 420 b.h.p. and 2,150 r.p.m. Its satisfactory condition at the end of the test showed that it had great possibilities for commercial operation. Five of these engines were then loaned by the Air Ministry to Imperial Airways and four were put into service in a Short Scylla type. The engines fully demonstrated the reliable service to be expected from the single-sleeve valve in commercial operation.

Fitted to a Squadron of Vildebeests two years ago, the Perseus VIII was the first Bristol sleeve-valve engine to be tested under Service conditions. Results had been most satisfactory as regards reliability, ease of maintenance, and, especially, continued serviceability.

Other types of Perseus had now been produced and, as compared with the Perseus I, the b.m.e.p. had been raised by some 40 per cent. and the b.h.p./sq. in. of piston area by 65 per cent. A number of improvements in design have been introduced, such as the accessory gear box adopted in 1936.

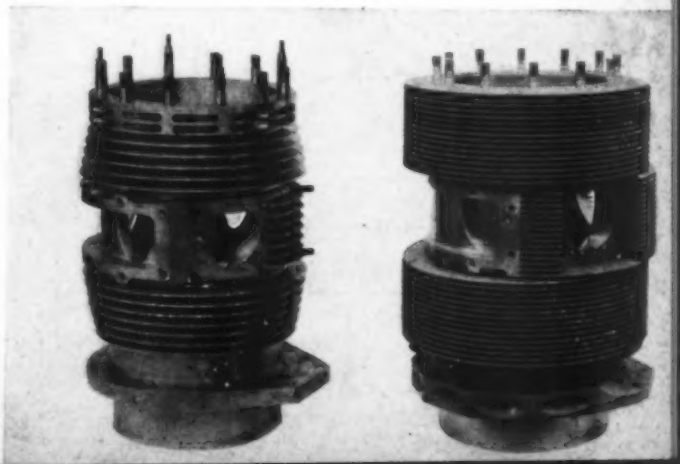
The latest Perseus engine was now in large-scale production and was being installed in a number of military aircraft, including the Lysander II and the Blackburn Skua, while two civil types so equipped were the latest Short flying boat and the D.H. Flamingo.

Another single-row sleeve valve was the Aquila, type-tested in 1934 and subsequently test-flown in the Vickers Venom fighter and the civil Bristol 143. Rearmament work had interrupted the development of this engine, but a recent resumption had resulted in its passing its civil test with satisfactory figures.

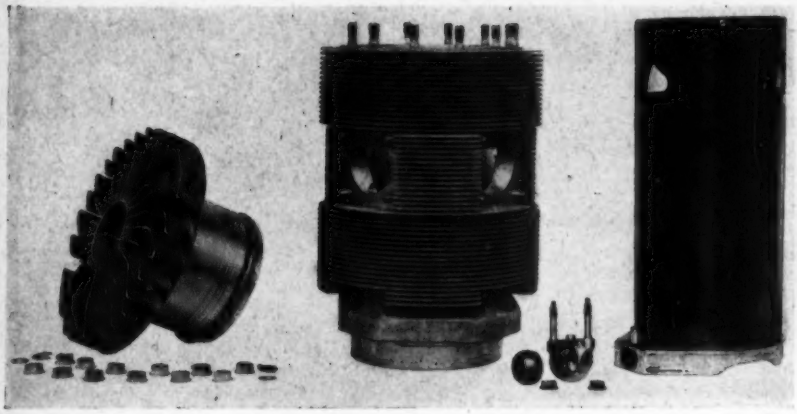
Turning to the two-row type, Mr. Fedden said that endurance flight trials of the Hercules were proceeding in a special Northrop. Of 2,360 cu. in. capacity, the Hercules was type-tested in 1936. It was then rated at 1,375 b.h.p. at 2,400 r.p.m. Other types of this engine would be developed for considerably higher powers with both 87- and 100-octane fuel.

The lecturer went on to describe the Bristol unit installation system, which was particularly happily developed in the case of the Hercules. He recalled that there was nothing really new in the idea of "an interchangeable power egg." In the Bristol Brandon produced 14 years ago, there was a swinging engine mounting, and the present-day Vickers Venom had a similar installation.

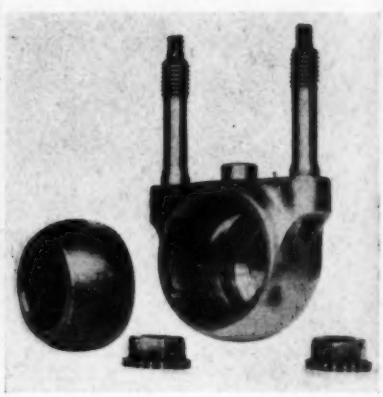
The latest Bristol sleeve-valve engine to be publicly announced was the Taurus, type-tested last summer for a



Evolution : The original sleeve-valve cylinder compared with a modern Perseus cylinder. Most noteworthy is the increase in finning.



The Perseus cylinder, with head and sleeve.



The standard driving-ball assembly.

maximum power of 1,065 b.h.p. The total experimental running on the four Bristol sleeve-valve types mentioned, the Aquila, Perseus, Taurus and Hercules, exceeded 14,000 hours.

Mr. Fedden then went on to discuss maintenance, saying that the only work required between overhauls was the routine servicing of plugs and magnetos.

The low fuel consumption and flat mixture loops had now been established. On a weak mixture test the fully supercharged Pegasus X had been run at 520 b.h.p. for 50 hours on a fuel consumption of 0.448lb./b.h.p. hr.

In the initial stages of development it was feared that starting difficulties might be encountered. At an early date, therefore, an extensive series of tests was made in a cold chamber placed at the company's disposal by Joseph Lucas, Ltd. Sleeve and poppet valve were investigated together, and the results were satisfactory. Later the cold-starting results were confirmed by a Perseus sent out to Canada.

Mr. Fedden set out the most important inherent advantages of sleeve-valve design as follows:—

(*a*) Total absence of maintenance except for plug and magneto servicing.

(*b*) Elimination of hot spots in the combustion chamber.

(*c*) Use of higher compression-ratios or boost pressures.

(*d*) Improved volumetric efficiency due to greater effective port areas.

(*e*) Centrally situated plugs, giving, if necessary, good performance on single ignition.

(*f*) Very flat mixture loops, permitting smooth running under conditions of extreme economy.

(*g*) Smooth running due to the good combustion chamber shape, and to the accurate and simple valve timing.

(*h*) More silent operation.

(*i*) Good accessibility and clean exterior appearance.

(*j*) Complete enclosure of all working parts, absence of external oil leads, and impossibility of oil leakage.

(*k*) Cooler exhaust.

(*l*) Freedom from lead corrosion.

(*m*) Greater freedom from cold corrosion.

(*n*) Regular cylinder shape, permitting the simplest form of baffling.

(*o*) Marked decrease in number of parts, and consequent reduced production and maintenance costs.

(*p*) Relative simplicity of all major parts, permitting accurate repetition machining.

(*q*) Probability of easier operation when exhaust turbo-blowers are used.

(*r*) Greater reliability due to most of the causes mentioned above.

(*s*) Any desired control of cylinder turbulence with its possible application to stratified charges and abnormally weak mixtures, with petrol injection.

Direct Fuel Injection

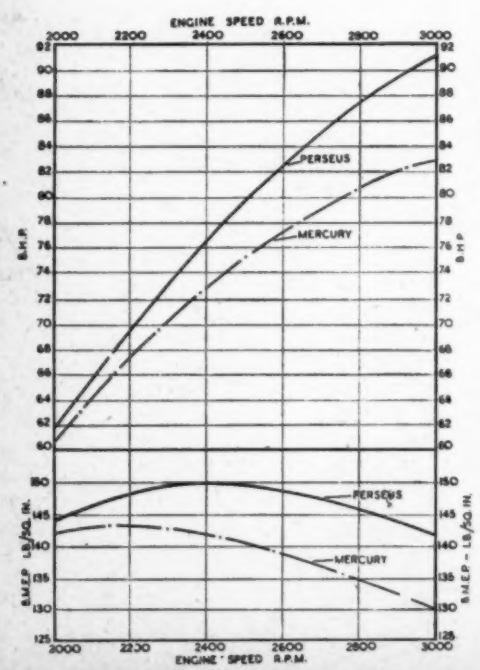
Mr. Fedden drew near his conclusion by foreshadowing future developments and answering some criticisms that had been aimed at the sleeve-valve.

The control of turbulence might be the most important factor in future development. Experience now available with small, high-speed Diesels had shown that direct injection of small quantities of fuel presented no insuperable difficulty. It should be possible to inject the fuel-air mixture very accurately over a wide range of operating conditions and to use fuels of low volatility.

While there were a few engine layouts which could not be conveniently met owing to the inability to provide space for the existing type of sleeve drive, most of the promising geometric forms could be accommodated, and the engine would undoubtedly make its appearance in multi-bank radial and H form.

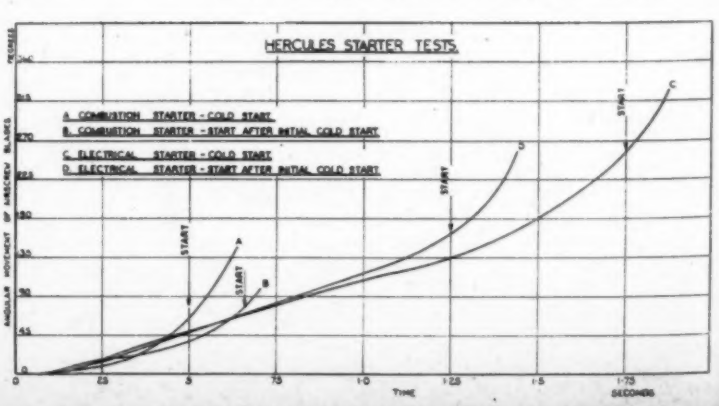
Many people have put forward the criticisms that in the event of failure of a sleeve-valve engine the resultant internal wreckage would be greater than in the case of the poppet-valve type. However, experience with a number of failures during development and overload testing had shown that that theory could not be supported on any ground.

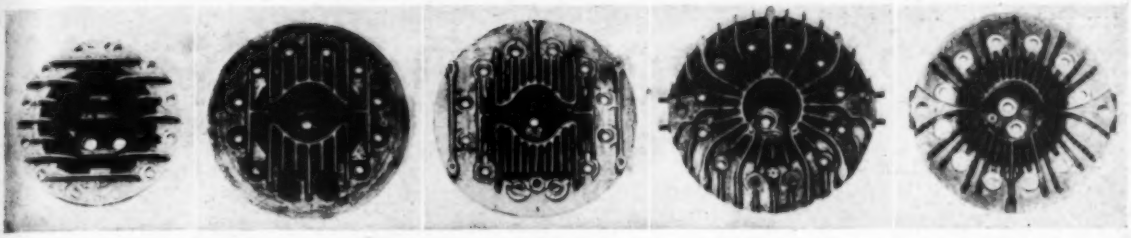
Mr. Fedden concluded with the following remarks:—



(**Left**) **Comparative power curves for Perseus and Mercury units. Full throttle; normal aspiration; 87 octane fuel. Compression ratio adjusted to give similar detonation.**

(**Below**) **Starting characteristics of the Hercules engine.**


HERCULES STARTER TESTS
A. COMBUSTION STARTER - COLD START.
B. COMBUSTION STARTER - START AFTER INITIAL COLD START.
C. ELECTRICAL STARTER - COLD START.
D. ELECTRICAL STARTER - START AFTER INITIAL COLD START.
START
ANGULAR MOVEMENT OF AIRSCREW BLADES
TIME
SECONDS



Stages in the development of heads for Bristol sleeve-valve engines. On the left is the original design, in which there was difficulty in carrying the air down to the centre of the head. In successive types various arrangements of baffles were tried. On the right is the present radial-finned head in Y alloy.

"During eleven years of mono-sleeve development for aero engines numerous engineers have warned the author against this form of valve mechanism, pointing out that the number of firms throughout the world who have tried to make a success of it and have eventually abandoned the design. He is glad to say that he has no fears on this score, and, although he does not claim that it is the only solution for the valve mechanism of high-power reciprocating internal-combustion aero engines of the future, he feels convinced that it is going to be a classic one.

"The author must admit, however, that, looking back over the years which have elapsed during his association with the development of the mono-sleeve valve, there were several times when failure to realise complete success after long periods of promising running gave him some qualms and called for a good deal of hard thinking. He then began to realise why other firms had given up the conflict, and he became convinced that the successful solution of the mono-sleeve was a long and deep furrow to hoe.

"The author has no hesitation in saying that, had it not been for the loyal support of an enthusiastic design and experimental team, considerable patience and encouragement from the Board, and the continued backing of the British Air Ministry, the present Bristol sleeve-valve development might quite well have had to be discontinued some years ago."

THE DISCUSSION

DR. D. R. PYE, Director of Scientific Research at the Air Ministry, was asked to open the discussion. He said that Mr. Fedden was the parent of the mono-sleeve valve aero engine but perhaps he (Dr. Pye) could claim to have been the humble but useful wet nurse who had supplied some of the sustenance during the infant's early years.

It was a good thing to look back sometimes, and he would recall the background against which the beginning of sleeve-valve research began. Prior to 1928 Mr. Ricardo had done a great deal of work on single cylinders, and had built a sleeve-valve racing car for the Vauxhall company. The units were all of the water-cooled type. He quoted from a paper he wrote for the A.R.C. in 1928, in which he said the sleeve-valve cylinder presented peculiar difficulties and that for the present its claims were bound up with the continuation of water cooling. A special panel was appointed under the chairmanship of Mr. (now Sir Henry) Tizard, and evidence was heard from a great many people. Excessive oil consumption was a legacy from the double-sleeve engine. It was feared that carbon would build up on the edges of the ports. The panel came to the conclusion that on a given fuel a sleeve-valve engine should be able to run at a higher compression ratio than the poppet valve engine without detonation. That led them to expect better thermal efficiency. It also seemed that when detonation did set in, it came on less suddenly. At the time it seemed important to get, on the naturally-aspirated engines used in those days, the best possible cylinder charging efficiency. Nowadays, with ground boosting, that was not so important.

The panel came to the conclusion that on a weight basis there was probably not much to choose between the two types of valve. The thing that seemed important was to get rid of the overheated exhaust valve, and the panel concluded: "We think that the sleeve-valve is worth development as offering far the greatest scope for advance in the production of high-duty engines of low rating per h.p., and we urge the experimental design of a complete engine." This was based on water-cooled sleeve-valve results, and it was not felt that building a complete air-cooled engine would be justified, but its advantages seemed to justify further single-cylinder research. That was the point at which Mr. Fedden and his staff took over the problem.

Dr. Pye then referred to Mr. Ricardo's experiments in 1928 with direct petrol injection into the cylinders of a sleeve-valve engine. It had been found that, by choosing the position and time of injection, one could get a stratified charge, with a rich mixture at the top of the cylinder and practically pure air near the piston. That made it possible to get high fuel economy under cruising conditions. He felt that this was a line of development worth exploring.

MR. J. F. ALCOCK recalled some of the early work of Ricardo, with whom he is associated [Mr. Ricardo is abroad at present]. One main trouble was connected with the sealing of the cylinder head. They thought split rings would catch in the edges of the ports and tried all sorts of solid rings, and no rings at all, but without success. Then they tried, in sheer desperation, a common or garden variety of piston ring and it worked perfectly. He confirmed the importance of the oval motion of the single sleeve. This helped to spread the lubricant. The oil film had to transfer heat by conduction and so had to be thin. Thus it was important that the cylinder and sleeve materials should have the same coefficient of expansion.

DR. W. H. HATFIELD paid a tribute to Mr. Fedden, and jestingly said that a typical procedure when they had one of their many conferences was that Mr. Fedden would begin by talking coefficients of expansion; then he pointed out that he must have greater strength and greater hardness. He must have a high Izod number, and just the right size of crystal and, of course, he could not put up with any non-metallic inclusions. In the end the metallurgists said "Thank goodness he is satisfied with the modulus of elasticity." He thought that, taking it all around, Mr. Fedden would admit that he had been given the materials he asked for. He thought the metallurgical world would meet demands during the next eleven years [the period of development under review] as it had done in the past eleven.

MR. J. D. PEARSON challenged some of Mr. Fedden's statements, particularly about breathing efficiency. He thought that the differences shown by the lecturer could be accounted for by changes in the induction and exhaust systems. On the subject of push-rod-operated valves, he said that he could appreciate the limitations, but with enclosed overhead-camshaft-operated valves the limit on speed was not imposed by the valve gear. He referred to figures from a Kestrel test unit, which had completed 1,318 hours of running without trouble from the valve gear. He finished up by expressing the hope that he had said enough to convince the audience that there was still a lot of life in the old poppet valve.

MR. T. HALL, of Imperial Airways, said he started off as a severe critic of the sleeve-valve engine, but after his experience with it in actual service he had become an advocate of it.

MR. TOM THORNYCROFT wanted to know where, approximately, the waste heat of a large aero engine went. He thought that in high-speed aero engines the sleeve valve was bound to win.

MR. G. MORRIS asked if there was any chance that the sleeve-valve engine had its own "hot-spot." He also quoted a poppet-valve engine which had been run successfully at a power of 7.9 h.p. per sq. in. of piston area.

MR. CANTRELL supported Mr. Fedden's figures, but thought that the air-cooled sleeve valve might possibly have a better application than the radial arrangement. He wanted to know if Mr. Fedden regarded K.E.965 as completely satisfactory for the sleeve.

MR. FEDDEN, in replying, said he did not regard Dr. Pye as having been merely "wet nurse" to sleeve-valve development; he would rather regard him as a fairy godmother who had produced the wherewithal to do the work. If Dr. Hatfield could produce something better in the way of materials they would be able to go still further ahead with development. He admitted that the Rolls-Royce poppet-valve engine had put up a very good show, but still felt that, at any rate for the large air-cooled and radial engine, the sleeve offered the better solution, if everything was taken into account.

Mr. Thornycroft had caught him out on the point of heat balance. They had done some work at Bristol and their engines gave an overall efficiency of 34 to 35 per cent., but he would not like to say from memory how the balance was made up.

"Indicator," in his "Topics of the Day," Complains About ——

TRANSPORT RIVALRY

and Discusses the Atlantic Service in Particular

THREE ARE OUT: An interesting picture (actually taken on January 25) from Seattle, showing three of the Boeing 314 boats moored together off Matthews Beach, Lake Washington. No. 1, in which interior fittings are now being installed, is on the left, while No. 3 (on the right) should, by now, have flown east for Atlantic experiments. Six of these boats have been ordered by Pan-American Airways.

Propaganda

ONCE again propaganda has been released in the United States in an attempt to convince everybody there that, whereas Pan-American Airways are quite ready to start a weekly (!) passenger-carrying Atlantic service, Imperial Airways are entirely unready. Indirectly, the assumption is made that American commercial machines are better, safer, more up-to-date and more efficient than anything produced on this side of the water.

The whole thing has had, as its background, the criticism directed against the people responsible for the equipment in the ill-fated *Cavalier*, which was lost when flying between Bermuda and New York. This is particularly curious, because only once in years has the American Press been really kind about British aeroplanes and operators—and that was when this particular flying-boat was first put on the Bermuda service. At that time the wayward aeronautical correspondents and others in American papers extolled the comforts and efficiencies of the Short Empire boat in comparison (presumably) with the deficiencies and discomforts of the Sikorsky S.42B which was used by the American company. Most of us know that the latter is pretty good—but there it is.

The fact is, of course, that neither Imperial Airways nor Pan-American airways are in any way ready to operate a regular transatlantic service. Of the two, Imperials have had a good deal more Atlantic flying experience, but, as I have said previously, it will be a year or two, at least, before any operator can possibly guarantee to run such a service on schedule while carrying fare-paying passengers. There is a tremendous lot to be learnt about direction-finding, navigation and, of course, weather conditions.

The Available Equipment

THEN there is the question of fleet. Admittedly, Pan-American Airways have two or possibly three of the new Boeing 314 boats, six of which have been ordered, and these are certainly the largest boats at present available But sheer size is only of interest where general seaworthiness is being considered. Whether the big 314 will be any more seaworthy than the "C" or modified "C" class boats remains to be seen. The latter, rather naturally, have their faults, but the test routine of the Boeing has also resulted in a series of modifications. It is always absurd to suggest that any particular machine is perfect.

Even with all six 314s in use it is still difficult to see how P.A.A. can operate regular services across the Atlantic while flying week by week, also, across the Pacific to Hong Kong and to New Zealand. The first of the 314s was originally earmarked for the last-named service; presumably the needs of Atlantic propaganda will mean that New Zealand will have to wait. There are still two Martin boats which can be kept on the Hong Kong service, but the schedules of all three services really demand the use of new and faster machines. At least two boats will be needed for each of the three oceanic routes—and a two-plus-two-plus-two makes six, leaving none for emergencies. Furthermore, the Atlantic and Pacific air bases are separated by 3,000 miles of land, so that there could be no rapid interchange of equipment.

As for civil machines in general, none of the American domestic airlines appears yet to have placed an order for the D.C.4, though K.L.M. are maintaining their order for a fleet of them. Apparently the type is rather too big for the needs of the American companies. Possibly the smaller D.C.5, which is to some extent a return to earlier ideas in transport design, will be more favourably considered. The Boeing Stratoliner has still to prove itself

Odious Comparisons

OVER here we have certainly had to place the Ensigns on one side for a moment and this fact has put Imperial Airways into an even more difficult position than that in which they were six months ago. Then, for better or for worse, they knew exactly how they stood, with a shortage of equipment for European and ex-European landplane services, whereas now they have taken on new commitments on the assumption that a new fleet will be available.

Nevertheless, there is nothing intrinsically wrong with the Ensign, and the fitting, for instance, of Wright Cyclones

—a change which is rather more than possible—and of constant-speed airscrews, will make the type not only one of the largest but one of the fastest in service. With new engines giving an additional 200 h.p. or so each, the cruising speed should go up to a figure in the region of 200 m.p.h.

In the meantime, and after a great deal of bad luck during the development period, the D.H. Albatross has proved itself and is now probably the fastest machine in commercial service. When the new fleet has gained the full confidence of the public it will be properly appreciated for its all-round efficiency. And if, three years ago, the Air Ministry had shown any foresight or generosity, the type might have been in metal. The new D.H.95, however, appears to have very good flying characteristics, while its performance is generally up to that of any similar high-efficiency design. Good characteristics, when they are available, are nowadays particularly appreciated by transport operators, who are in a difficult position where a non-docile machine is concerned. Only their very best and most experienced pilots may at first be put in charge of anything which requires careful handling, while considerable expenses are incurred in giving the necessary training to the junior members of the flying staff. Quite apart from safety considerations, a reasonably foolproof aeroplane saves a company a very great deal of money in incidental operations.

For the moment, there is nothing available in this country in a somewhat smaller category for those few operators who demand a cruising speed of the order of 200 m.p.h. At least one internal airline company in this country is seriously considering the purchase of an American type. Very few companies can afford to build up the traffic, even on a trunk route, while using fast fourteen-seaters; what they want for a start is something equally fast carrying six or seven passengers. Later on, when and if the traffic has been built up, they can re-equip with larger types. It is rumoured that both Imperial Airways and Railway Air Services are interested in the 95. Presumably, the latter might find it reasonable to use such a machine on their Belfast run. Certainly the ground communications in this country are so good that only speed and frequency can permit the mass sale of air transport to the general public.

Goodness knows there is enough to complain about in air transport, but it hardly helps matters if this fatuous competition (of simple propaganda interest) is intensified. Both Imperial and Pan-American Airways have a great deal to learn about scheduled Atlantic flying—as those who are immediately concerned with the job will admit at once.

Nobody, as yet, has any reason to be proud of the progress of air transport. Both in America and Europe the companies kill unsuspecting passengers with monotonous facility. The best we can do is to co-operate to the full for the purpose of obtaining efficiency *with* safety—and at least stop this squabble about relative superiority.

Ask the Airline Pilot

MY recent remarks about the need for more co-operation between the airline operator and the manufacturer has produced a most stirring and informative letter from the Guild; this appears in the correspondence columns elsewhere in the issue.

First of all, I must apologise for the somewhat loose remark that the G.A.P.A.N. "should have stepped in"; I ought to have said: "Should have made more vigorous efforts." Whatever the Guild may say (and nobody denies that it has done a tremendous lot of very good work) the average airline pilot still feels neglected—and hence, to some extent, the formation of another organisation.

The gist of my contention was that airline pilots should be given the very first attention by manufacturers. It is not enough that it should be "obvious" that manufacturers "would do well to call senior airline pilots into consultation." For years before 1936 such consultations should have been in the natural and obligatory order of events.

INDICATOR.

Private Flying

FROM the CLUBS and SCHOOLS

LONDON.

THE time flown by the London Aeroplane Club members during the week ended February 4 amounted to 71 hr. 15 min. During last week 76 hr. 45 min. were logged, and Mr. R. H. Grattan-Doyle made his first solo flight.

BARTON (BEDS).

The Bedford School of Flying experienced good weather for the week ended February 4 and Messrs. F. A. Armstrong, A. Gregory and N. P. Anson made their first solos.

Mr. S. K. Johnson flew his first solo last week. There are vacancies in the Civil Air Guard section.

PLYMOUTH.

There was only one day's good weather and gales prevailed for the rest of the week ended January 31. Thirteen hours were flown and Mr. R. G. Cottey made his first solo flight.

Four days were spoilt last week by bad visibility, but 55 hours' flying was done in the remainder of the week.

WESTON.

The week ended January 31 proved to be one of appalling weather and only 9 hours were flown. The club has acquired a Swallow and now has two machines of this type, together with a Hornet Moth.

Weston was unlucky again with the weather last week, but 33 hours were flown in the 3½ days on which instruction was possible.

EXETER.

The club held a very successful dance at the airport on Monday, January 30, when nearly a hundred members and friends were present. During the week ended January 31, 16 hours' flying was done.

The weather was fine last week, and although only one aeroplane was in commission, 40 hours' flying was done.

EASTBOURNE.

In spite of low clouds and high winds, 70 hours were logged for the two weeks ended February 10. Messrs. E. H. Bayliss, H. S. Viner, and the Misses D. P. Wilson, and Patricia Woollan all made their first solos, while Mr. R. C. Hall-Headly passed his "A" licence tests. Messrs. D. L. Brown and J. H. Carter have succeeded Capt. E. I. Short as joint hon. secretaries, while Miss Margery Spiller has taken over from Mr. W. S. Coates as instructor in conjunction with Mr. T. G. Stubley. Messrs. T. H. Dinnis and W. U. Bedford have now obtained their licences.

STRATHTAY.

During January, flying amounted to 99 hours, of which the Civil Air Guard accounted for 55 hours. Five licences were obtained during the month and Messrs. Stableforth and Rose went solo.

THANET.

Although the weather was mainly unsuitable, 28 hours were flown during the last week in January. Mr. W. Smith passed his "A" licence tests. The Dragonfly, Miles Whitney Straight, Autogiro and Swallow belonging to the president, Mr. Albert Batchelor, have been acquired by the Straight Corporation and the first three have been added to the Ramsgate fleet.

Last week started badly with four days spoilt by low cloud, but 49 hours were flown in the remaining three days.

NORFOLK AND NORWICH.

In spite of some blank days, flying hours for the week before last showed an increase on recent figures and in the Civil Air Guard section another member made a first solo. Mr. C. G. Gowing and the chief instructor made a trip to Hatfield to see about the purchase of two Moth Minors. Delivery is anticipated about the end of June.

In spite of two blank days there was a further increase in flying last week, the total hours flown being the highest recorded since the first week in December.

IPSWICH.

The Hillson J.A.P.s have given excellent service in the first few weeks since modification and 42 hours were flown during the week ended January 31 in spite of bad weather. Lady Evelyn Balfour—a Civil Air Guard member—made her first solo flight.

Long-awaited fine weather enabled the club to achieve the excellent total of 118 hours during the week ended February 7. Messrs. Barfield, Cooper and Pharaoh made their first solo flights, and Messrs. E. Frye, H. Lake, W. Barnard, B. Firman, L. Corder, G. Hitchcock and L. Stagg passed their "A" licence tests. With one exception these pupils are members of the Civil Air Guard.

YORKSHIRE.

The universal wintry conditions rather affected flying during January, but a week's good weather brought the total up to 180 hours for the month. This compares very favourably with the 58 hours which were logged for January, 1938. Mr. J. N. Airey obtained his "A" licence under the C.A.G. scheme.

So far during February 55 hours have been flown, 38 hr. 30 min. of which were put in last week. The club has purchased another Moth, which brings the total fleet up to 15. Part of the club's workshops have been moved across into the new hangar.

Private Flying

YAPTON.
Between February 1 and 11 a total of 11 hr. 5 min. were flown by the Yapton Aero Club, while 70 hr. 5 min. flying was recorded by the C.A.G. section. Twelve members are flying solo in this section, and three members have already qualified for their "A" licences.

HANWORTH.
No flying was possible on two days last week owing to bad visibility, and 71 hours were recorded. Messrs. E. Iredale and M. Sayer made their first solos, and Mr. Senecal and Mrs. D. Paterson have qualified for their "A" licences. The club has added a further three Cirrus Swallow aircraft to its fleet, making a total of 7.

NORTH BRITISH.
Only 6 hr. 25 min. were flown by Civil Air Guard members for the week ended February 10. On three days flying was impossible owing to high winds. No flying was possible on three days of the previous week owing to bad weather and only 4 hr. 50 min. flying was logged by Civil Air Guard members.

COTSWOLD.
Quite a good number of members and friends turned out on January 27 for the Cotswolds Aero Club's fifth annual dance. This was held at the New County Hotel, Gloucester, where the rooms were appropriately decorated in the club colours. Although the official time for the end of the dance was, as usual, 2 a.m., a score or more of the die-hards collected elsewhere to continue the party.

CINQUE PORTS.
Messrs. D. Clark and R. A. Dunster, Civil Air Guard members, have made first solo flights during the week ended February 5, in which the total was 36 hours.

The encouraging spring-like weather of the past few days permitted a flying total of 60 hours to be logged for the week ended February 12. On Sunday alone, 19 hr. 25 min. was put in. Two more Civil Air Guard members—Messrs. Wing and Jordan—have obtained their "A" licences, while Messrs. Clark, Dunster and Slade went solo.

WITNEY AND OXFORD.
A first solo by Mr. T. Gwillim and completion of "A" licence tests by Mr. J. D. Doe were included in the flying report for last month, which showed a total of 94 hr. 45 min. During the first four days in February, 23 hr. 15 min. were flown. Mr. K. Hiskens is a new member.

Although three days were blank owing to bad weather a total of 33 hr. 40 min. flying was logged for the week ended February 11. C.A.G. ground lectures on two days of the week have been started and are well attended.

BROOKLANDS.
January 5 proved to be the best flying day for weeks and all machines were fully booked during daylight. Incidentally, nearly 30 hours were logged by seven aircraft. In the morning a demonstration of the Cub coupé was given by Mr. A. J. Walter, when some members had an opportunity of flying it. During the afternoon Mr. K. Waller gave an aerobatic display. Mr. Rudolph Kahn passed his height test during the week.

Mrs. K. Lund and Messrs. Hiscock, Kahn and Longhurst took their "A" licences last week, while Messrs. Heitner, Brown and von Maltitz went solo.

SOUTH COAST.
Miss C. Mackenzie, of the Civil Air Guard, made her first solo during the week before last, and there were 18 members ready for their "A" licence tests. The majority of the flying total of 20 hours was contributed by C.A.G. members.

Mr. W. O. Cooksey, of the Civil Air Guard, qualified for his "A" licence last week, and it is anticipated that several others will be eligible over the week-end. It is hoped that further enrolments of the C.A.G. may be made in the very near future. Forty-three hours of club flying were put in last week, and Miss J. Heath did her first solo.

NORTHAMPTON.
Club flying was brisk last week, the time logged being very satisfactory for the period of the year. Mrs. E. Goldsmith secured her "A" licence, and two new members joined.

YORK AND LEEMING.
Civil Air Guard members put in 110 hours during January, and two "A" licences were obtained—by Messrs. J. S. Littlewood and A. F. Marshall. Messrs. L. W. Chatto, C. E. Stamp, K. A. Horner, J. Dalling, and G. A. Theyer made their first solo flights.

PORTSMOUTH.
Twenty-two hours ten minutes were flown between February 1 and 11 in the Civil Air Guard section, and fourteen members have now qualified for their "A" licences. Club flying last week totalled 31 hr. 15 min.

NOTTINGHAM.
Tollerton aerodrome will be closed in its entirety on each Monday. During January, 150 hours were flown by C.A.G. members, and first solos made by Miss Webber and Messrs. Kenrick, L. Hoffen, G. A. Pearson, Meek, T. Arthur, Dearden, and Walker. Messrs. J. Marshall Ponder and Haviland qualified for their "A" licences.

BORDER.
Weather conditions still continue to hold back flying progress, and during last week it was only possible to fly during one morning. However, during that morning several solo members put in time for their "A" licences, and Mr. W. T. Tiffen completed his tests. For February a total of 17 hr. 50 min. has been flown.

MARSHALL'S.
Flying for the week ended February 4 at Marshall's Flying School amounted to 94 hr. 55 min. Messrs. Addinsell, Crook and Standen completed their first solo flights.

During the week ended February 11 a total of 131 hr. 10 min. flying was logged. Mr. Condor made his first solo and has also completed his "A" licence tests. In the Civil Air Guard, Mr. Cole completed his "A" licence tests and Mr. Walker went solo.

WORCESTERSHIRE.
The Worcestershire Flying Club has continued to prosper, although flying hours have been fairly low owing to adverse weather conditions. The Civil Air Guard section has a waiting list, and lectures are in full swing. Mr. J. C. Jude has joined the staff as instructor. During the first twelve days of February a total of 53 hours' flying was recorded. The club now has four machines and three instructors.

ROMFORD.
Wind, rain and mist prevented flying on all but two and a half days of the week before last, but 43 hours were logged. Mr. J. R. Mace, as a C.A.G. member, qualified for his "A" licence after 10 hours' solo. The C.A.G. hold their first social and dance tomorrow (February 17).

Sixty-seven hours were logged at Chigwell last week, and first solos made by Messrs. Nicholson and Onslow. The president's dance at Maylands in aid of the No. 6 Romford A.D.C.C. proved a great success.

NEWCASTLE.
In spite of the cold, wet weather, flying was possible on most of the days and a total of 24 hr. 45 min. was logged in the club and 113½ hours in the C.A.G. for the week ended February 4. Miss M. A. Jackson and Messrs. C. G. D. Airey, O. A. Eagling, W. J. Murray and F. G. Wall carried out first solos. A pot-pie supper on January 20 was well attended, and a provisional date—March 16—has been fixed for the C.A.G. dance.

Every day except one was suitable for flying during last week and 63½ hours were logged, of which 52½ hours were put in by C.A.G. members. Mr. R. Clavery made his first solo.

STRANGE BUT LOGICAL: The G.A. Cygnet in its latest form, with twin rudders and tricycle undercarriage. In due time, of course, the forward leg will be faired; this wheel is steerable, but it may be locked in a fore-and-aft line if required.

THE ROYAL AERO CLUB

News and Official Notices for *the Week Ended February 11*

Record Regularity

PROVISIONAL calculations made at the Royal Aero Club this week show that Mr. Alex Henshaw completed his out and back flights between Gravesend and Cape Town with the rhythmic regularity of the bob of a pendulum.

Only eleven minutes separated his time for the outward journey from that of the homeward journey. On the basis of 9,652.313 km. (5,997.9 statute miles) this is a variation of 1.131 km/hr. (0.7 m.p.h.), which is believed to set a new standard of regularity for such a distance.

Directly the log sheets reach London from Cape Town, the figures will be rechecked and an official claim for a capital-to-capital international air record, category 1 (for solo flyers) will be submitted to the Fédération Aéronautique Internationale.

The provisional figures indicate an average speed "out" of 244.876 km/hr. (152.1 m.p.h.) and "back" of 243.745 km/hr. (151.4 m.p.h.). The times were 39 hr. 25 min. and 39 hr. 36 min. The previous record "out" was held by Miss Amy Johnson at 122.65 km/hr. (76.2 m.p.h.) with a time of 78 hr. 28 min. The return journey record was held by Mr. H. L. Brook with 100.454 km/hr. (62.4 m.p.h.), time 96 hr. 20 min.

Air Tourist Radio

A WORLD-WIDE wavelength reservation for touring aeroplanes has been made by the Third World Conference of Aeronautical Radiotelegraphy experts in Paris.

This means that as soon as the necessary ground facilities have been provided, communication can be established between a touring aircraft in any part of the world and the appropriate ground stations. It is believed that increased safety and improved navigation will result from this step.

The report giving details of this reservation was received during the week from the Fédération Aéronautique Internationale. It stated that the special service for touring aeroplanes, which could also be used as an auxiliary service for public transport aircraft, had been fixed at the following frequencies:—

Ground station: 37.0 Mc/s.
Aircraft station: 37.2 Mc/s.

The following auxiliary frequencies may also be used:—

Ground stations: 36.6 and 36.8 Mc/s.
Aircraft stations: 37.4 and 37.6 Mc/s.

The service will be operated by radiotelephony (A3) or by radiotelegraphy on modulated waves (A2).

To enable ground stations to obtain bearings, touring aeroplanes may give an automatic signal on 327 kc/s after permission has been obtained from the ground station on the ultra-short wavelength.

Originally the idea of the Egyptian Royal Aero Club at the London Conference of the Fédération Aéronautique Internationale in June, 1937, the reservation of a wavelength for touring aircraft was discussed and recommended by a sub-committee of the F.A.I. on which the Royal Aero Club was represented.

The sub-committee was composed of His Excellency Taher Pasha (Royal Aero Club of Egypt), M. Raty and M. Chollat (Aero Club de France), and Major A. Goodfellow and Sqn. Ldr. Spence (Royal Aero Club).

Visited by the Stork

LARGE birds which include the white stork are now to be found on all landing grounds in Uganda.

A *Notice to Airmen* received during the week by the Royal Aero Club states that these birds are likely to be found throughout the year, but it is added that special care should be taken during the months of October to April, inclusive, by pilots landing at Gulu, Lira, Soroti and Tororo. All these are situated on the main migratory route of the white stork.

New International Signal Book

The Royal Aero Club has been informed that the International Commission for Air Navigation (I.C.A.N.) has issued a signal book with the purpose of facilitating the exchange of signals between aircraft, between aircraft and ground stations and between aircraft and ships.

The book is divided into three parts: (1) Description of signals and signalling devices. (2) Instructions for drawing up, sending and receiving messages. (3) Codes.

The booklet can be obtained from the "Secretariat de la C.I.N.A.," 60 bis, Avenue d'Iéna, Paris, for the sum of 40 French francs.

Air News

ESTONIA.—Particulars have been received of six prohibited areas, or regions closed for private aircraft, which came into force on December 29, 1938.

FRANCE.—Work is in progress at *Le Bourget-Dugny* Aerodrome on the concrete apron of the "arrival" side of the main airport building, and will last approximately five months. The area is railed off, but airmen are requested to taxi slowly in its vicinity.

IRELAND.—Anti-aircraft firing practice will take place up to February 27 at *Gormanston Camp*, 6¾ miles S.E. of *Drogheda, Co. Louth*. The area within a 10 miles radius of *Benhead, Co. Meath*, has accordingly been declared as a danger zone.

In addition, air exercises, including target towing, may be carried out on any day up to May 15 in the vicinity of *Baldonnel Aerodrome*. Pilots are requested to exercise special care.

SWEDEN.—A copy of the Swedish regulations governing flights in bad visibility has been received. In addition, the British Air Ministry has issued particulars of the general Air Navigation Regulations for Sweden, in booklet No. 25.

Congratulations

TO Miss Mary Foote, who has been personal Secretary to Cdr. Harold Perrin, Secretary of the Royal Aero Club, for the past eight years, on her marriage this week to Mr. A. Ulmann.

Aviators' Certificates

No.	Name.	Club or School.	Date.
16,980	Jack Noble Airey	Yorkshire Aeroplane Club...	31.1.39
16,981	James Robert Mace	Romford Flying Club ...	3.2.39
16,982	John Dawson	Eastbourne Flying Club ...	3.2.39
16,983	James Timothy Howard ...	Plymouth and District Aero Club.	27.1.39
16,984	Douglas John Montague Pink ...	Malling Aero Club	4.2.39
16,985	Robert Maun	No. 9 Flying Training School, Hullavington.	2.2.39
16,986	Hugh John Yeomans Lake ...	Ipswich Aero Club	3.2.39
16,987	Robert Wilfred Taylor ...	Newcastle Aero Club ...	2.2.39
16,988	Robert William Forsyth ...	Newcastle Aero Club ...	3.2.39
16,989	George Edward Himing ...	Redhill Aero Club	20.1.39
16,990	Leonard Edward Moyse ...	Malling Aero Club	5.2.39
16,991	Philip Henry Inigo Jones ...	Midland Aero Club	24.1.39
16,992	Margaret Sybil Thring	Witney and Oxford Aero Club.	5.2.39
16,993	William James Patrick Walker	Portsmouth Aero Club ...	4.2.39
16,994	Melvyn William Sheppard ...	Yapton Aero Club	6.2.39
16,995	James Eric Swift	Cinque Ports Flying Club...	28.1.39
16,996	Arthur James Curley	Grimsby Aero Club... ...	5.2.39
16,997	Albert Greetham Zealand ...	Grimsby Aero Club... ...	5.2.39
16,998	Marjorie Emily Meredith Hunter	Scottish Flying Club ...	1.2.39
16,999	Betty Gordon Jones	Kent Flying Club	4.2.39
17,000	Richard John Wing	Cinque Ports Flying Club...	7.2.39
17,001	Douglas Raymond Weir ...	Hampshire Aeroplane Club	5.2.39
17,002	Carl Mumby	Grimsby Aero Club... ...	6.2.39
17,003	William Thomas Tiflen... ...	Border Flying Club... ...	7.2.39
17,004	Milford Fearnley Cockroft ...	County Flying Club ...	7.2.39
17,005	Basil Eric Algernon Joyner ...	Redhill Flying Club ...	4.2.39
17,006	Roger Harvey Hurst	County Flying Club ...	5.2.39
17,007	Arthur Edward Henry Coltman	County Flying Club ...	5.2.39
17,008	Trevor Laurance McAlpine Woods.	Redhill Flying Club ...	24.1.39
17,009	Leonardo Henriquez	Autogiro Flying School ...	7.2.39
17,010	Joseph Arthur Mitchell ...	Wiltshire Flying Club ...	5.2.39
17,011	Thomas Herbert Gibson ...	Doncaster Aero Club ...	6.2.39
17,012	Terence Claud Francis Earp ...	Newcastle Aero Club ...	5.2.39
17,013	Peter Robert Lutley	Portsmouth Aero Club ...	3.2.39
17,014	Winifred Hilda Goldsmith ...	Northamptonshire Aero Club	4.2.39
17,015	Eric Arthur Redfern	Norfolk and Norwich Aero Club.	7.2.39
17,016	Brian Herbert Evans	Cardiff Aeroplane Club ...	7.2.39
17,017	Eric Charles Owen	Weston Aero Club	5.2.39
17,018	Cecil Holt Senecal	London Air Park Flying Club	12.1.39
17,019	Daphne Paterson	London Air Park Flying Club	7.2.39
17,020	Raymond Cecil Hall-Hedley ...	Eastbourne Flying Club ...	7.2.39
17,021	James Cosmo Melvill	University Aero Club ...	9.2.39
17,022	James Arthur Norris	University Aero Club ...	9.2.39
17,023	Jack Dennis Doe	Witney and Oxford Aero Club.	9.2.39
17,024	Guy Kestell Pridham	Exeter Aero Club	9.2.39
17,025	Raymond Hosking	Exeter Aero Club	9.2.39

COMMERCIAL AVIATION

ON TEST : The new Boeing 307 Stratoliner flying at 11,000ft. with its two starboard Wright Cyclones stopped and the airscrews feathered. During this flight the machine had an all-up weight of 45,000 lb. The way in which the rudder is being held over to counteract the drag of the stopped engines is noticeable, but more interesting is the white leading edge of the tailplane. This is a paint coating to record the direction of the flow of fuel in dumping tests during which coloured water was used instead of petrol.

THE WEEK AT CROYDON

"A. Viator" Considers, with Pardonable Concern, the New Collision Danger, Speaks of Strange Cargoes and Mentions Bombs

ONE day last week I witnessed the somewhat subdued departure of Dr. Ley and his party, of the "Strength Through Joy" movement, in a special Junkers Ju.52, *Hermann Goering*. Spick and span though the machine was, I felt that it needed to be a bit more decorative.

I don't know much about this "Strength Through Joy" business, for I find that the more joyous I am (at an annual airport dinner, for example) the less strong I feel next day. Joy may, of course, be found together with strength in a spot of nourishing oatmeal stout with a glass of port added to it—a compound new to me, but definitely prescribed by an expert, who desires to remain anonymous. He calls it "dog's blood," but it struck me as being more like that of an elephant with high blood pressure and malaria.

Not very long ago good old *Heracles* had the laugh of all other forms of transport—road, sea and rail—on a day when there was thick ground fog and clear sky above it. It took the passengers one and three-quarter hours to get down to Croydon from London, a record which *Heracles* very nearly broke between Croydon and Paris.

A good deal of annoyance and considerable danger is occasionally caused by young and thoughtless Air Force pilots playing "tiggy-tiggy-touch-tail" in and out of the clouds in the fairly immediate vicinity of Croydon. Collision has been but narrowly averted more than once, and as it is useless to report the type of machine to the authorities, one or two commercial pilots have decided to chase these lads and get their numbers.

When that happens it will not be the particular R.A.F. lad's horoscopically lucky day, for we have already been promised by a very high R.A.F. authority that if we will first catch the aerial hare he will cook it for us to a turn.

No fewer than 40 monkeys recently left London (for Rome ultimately) by the German night freighter. Being originally inhabitants of a mandated territory, some suspicion was at first aroused, but their leader was understood to inform Our Special Airport Zoological Correspondent, an elderly baboon in a battered bowler, that the visit had no political significance.

I know one talks about a pride of lions, but what about peaccks? Is it a pogrom of peacocks, a plethora thereof, or is it, maybe, a panic of peacocks? Anyway, some fourteen of these elegant fowl arrived by K.L.M. the other day—it looks as if some armament king has already acquired a stately home of England.

Peacocks and apes, eh? All we need now is a package of ivory, and the only thing of this sort I have seen was the result of a flashing smile directed at a Press photographer when the well-known star, Mlle. Ohlala (*née* Coolummy), stepped from a Paris machine the other day. But they do say, quite seriously, that there is an air traffic in dentures, dental plates, and the like between this country and the Continent. Possibly it's to do with those mysterious financiers who are always advertising "good price paid for old false teeth."

Precautions

The outcry against jitterbugs does not seem to me to be entirely justified, for there are some people who stay comatose until a supply of these jolly little creatures have been injected into them from a syringe with a carefully sharpened nozzle. Hence, maybe, the recent formation of an A.R.P. committee at Croydon to consider the measures to be taken for last September's crisis. (Incidentally, reverse letters in jitterbugs and you get bitter jugs, which is the sovereign cure for the complaint. Nobody with a jug of good old English ale circulating through his system can have the jitters.)

A rumour has reached me that the authorities told someone that they supposed they would have to do something about the 300ft. chimney which the Croydon Council propose to erect, quite innocently, in this neighbourhood, because of the publicity given to the matter in the columns of *Flight*.

All companies here at Croydon have been warned to look out for these alleged Irish who are perpetrating the singularly mean and cowardly acts of sabotage. We all wish we could catch one of these nasty little men.

Not to end on too serious a note, did you hear the rumour that a dance expert had left London for Rome by air? They say that someone has discovered that the passo Romano is a bit Nordic, and that there is talk of substituting the passo Lambetho.

A. VIATOR.

Warsaw-Rome

IN May, Polish L.O.T. will be starting a new service between Warsaw and Rome. The route will be via Budapest, Zagreb and Venice. Lockheed Fourteens will be used. Four more of these have recently been ordered by the company.

Stockholm-Moscow

SWEDISH AEROTRANSPORT and the Soviet Aeroflot have agreed to operate a Stockholm-Moscow service for six months during this year instead of for the three months' period over which it has been operated during the last two seasons. The service will start on May 3 and will continue until November 4, with one run in each direction on all week-days.

East African Extensions

THIS year Rhodesia and Nyasaland Airways (familiarly known as RANA) are operating two additional services. Both of them are weekly in each direction, the first linking Luska, Mumbwa, Mankoya and Mongu, and the second Lusaka with Nyimba and Fort Jameson. RANA are, of course, part of the Imperial Airways group and, with Wilson Airways, feed the inland areas from the coastal route.

Guernsey's New Aerodrome

WORK on the terminal building at the new Guernsey aerodrome is proceeding rapidly, and arrangements have been made both for the erection of a hangar, which will be rented to Guernsey Airways in due course, and for the extension of the apron.

The official opening will be on Friday, May 5, and Sir Kingsley Wood, the Secretary of State for Air, has promised to perform the ceremony.

Faster to Abyssinia

UNTIL recently Ala Littoria have been using CANT Z506s on the first (Rome-Benghazi) section and three-motor Savoia Marchetti S73s on the last section of their Addis Ababa line, the land machines putting down at Cairo, Wadi Halfa, Khartoum, Kassala, Asmara and Dire Daua. The whole journey from Rome took a matter of about four days. Since January 1 Ala Littoria have been using Savoia Marchetti S75 machines over the whole run and have eliminated the stops at Kassala, Asmara and Dire Daua. The service now takes only two and a half days.

New Services in Palestine

A CONCERN known as the Commercial Aviation Company has recently started the operation of services from Tel Aviv, Palestine, to Transjordan, Iraq, Syria, and Lebanon. Since the company is at present using only one machine, a Fokker F.18, it is to be presumed that the services are more in the nature of charter trips. This F.18 previously belonged to K.L.M., and was recently flown out from England by Mr. W. Dushinsky, who was formerly a private pilot to Mr. Jan Bata, the Czecho-Slovakian manufacturer. Another similar machine has, it has been reported, been purchased.

To the Races

AFTER a five-day hearing by the Air Transport Licensing Authority, certain preliminary decisions were made in the matter of licensing those charter companies which make a point of flying to race meetings.

Of the four applicants, British-American Air Services were the most favoured—which is not unnatural in view of the fact that they have specialised in this type of work since first starting operations three years ago. They have been licensed to carry passengers between Heston and a very large number of racing centres. Channel Air Ferries may operate in March between Croydon and Liverpool; Olley Air Services may, between March and November, run between Croydon and Doncaster and Newmarket; and Railway Air Services are authorised to run between Croydon, Birmingham, Liverpool, and Manchester. Provisional licences will be issued to the last two companies for special occasions.

Walk Before You Fly

AN amusing but very worthwhile method of familiarising pilots with the audible signals from an approach transmitter has been tried out successfully in France and has been adopted by Air France for blind-flying training.

The pupil is equipped with earphones attached to a portable receiver which is strapped to his chest. He is then blindfolded and made to walk forward, correcting any deviation to right or left which is indicated by the signals transmitted by the track beacon. While walking forward in a straight line he receives, of course, a steady signal; this changes to dashes with deviations to the right, or dots with deviations to the left.

A number of Imperial Airways pilots are to go to France to undergo courses of instruction by the new and distinctly cheaper method. The system taught by this method is the L.M.T., which is similar to the Lorenz in principle. The home of the innovation is Trois, the training ground for Air France pilots in the South of France. Trust the French to produce a logical training method—regardless of appearances.

To Bermuda

THE ill-fated *Cavalier's* place on Imperial Airways' New York to Bermuda service will be taken by *Champion*, one of the new modified "C" class boats. This machine was actually launched before Christmas and it is now being used on the Empire Services; it made its maiden flight in November, taking the mails through from Southampton to Sydney.

For this new service *Champion's* tankage will be increased to give a normal range of approximately 1,500 miles, while the radio equipment will be improved by the installation of duplicate receivers. Additionally, a retractable transparent dome for sextant work will be fitted above the pilot's compartment. The seating accommodation, too, will be rearranged to fit in with American ideas, and there will be two smoking cabins.

Interestingly enough, the machine will fly out to its new base in Bermuda, via Lisbon, Bathurst (West Africa), Natal (Brazil), Trinidad and Antigua, and for this purpose extra tanks will be fitted. During the trip the crew will make a study of conditions over the route. Later on, when British Airways extend their projected West African service to South America, it is probable that the company will be using flying boats—either the new modified "C" class Shorts or the "G" class boats which are now in course of construction.

D.C. Fours and Fives

SINCE the original statement made in Australia some months ago that K.L.M. had ordered eleven D.C.4s mainly for use on their Far Eastern service, there has been until now no official pronouncement from the company. In fact, doubts have been expressed in this country and elsewhere about interest or otherwise shown by K.L.M. in this large transport aeroplane. These doubts were concerned not so much with the virtues or otherwise of the machine, but with the advisability of its use on the Far Eastern service, in view of its weight and size. It might be remembered that Imperial Airways were intending and still do intend to use the Ensigns on the landplane service to India, and this machine is not much less heavy than the D.C.4, while the aerodromes beyond India are largely the affair of K.L.M. themselves. It is now reported that a provisional order will be placed for six D.C.4s, each to have four Pratt and Whitney twin-Hornets.

More than a fortnight ago, too, news arrived from Holland that the company had also ordered four D.C.5s, mainly for service on the company's internal air routes. This type is, of course, a high-wing twin-engined machine bearing a certain general resemblance to the D.H.95 described in this week's issue and having a somewhat similar performance and load capacity.

It is not expected that the first of the D.C.4s will be delivered (and possibly flown over) before 1940, but all four of the D.C.5s are expected during the latter part of this year, the first to arrive in September. This is interesting. At the moment the prototype D.C.5 has not even flown.

Specialising in Instruments

QUITE recently a new subsidiary company was formed by Rollasons, of Croydon, which company will, so to speak, enable the firm to set aside a considerable area of their shops for work on instrument maintenance, overhaul, and, for that matter, rebuilding. The company is known as Rollasons Aircraft Instruments and Equipment, and will be in charge of Lt. Cdr. J. R. Bryans, who is a director of the parent company.

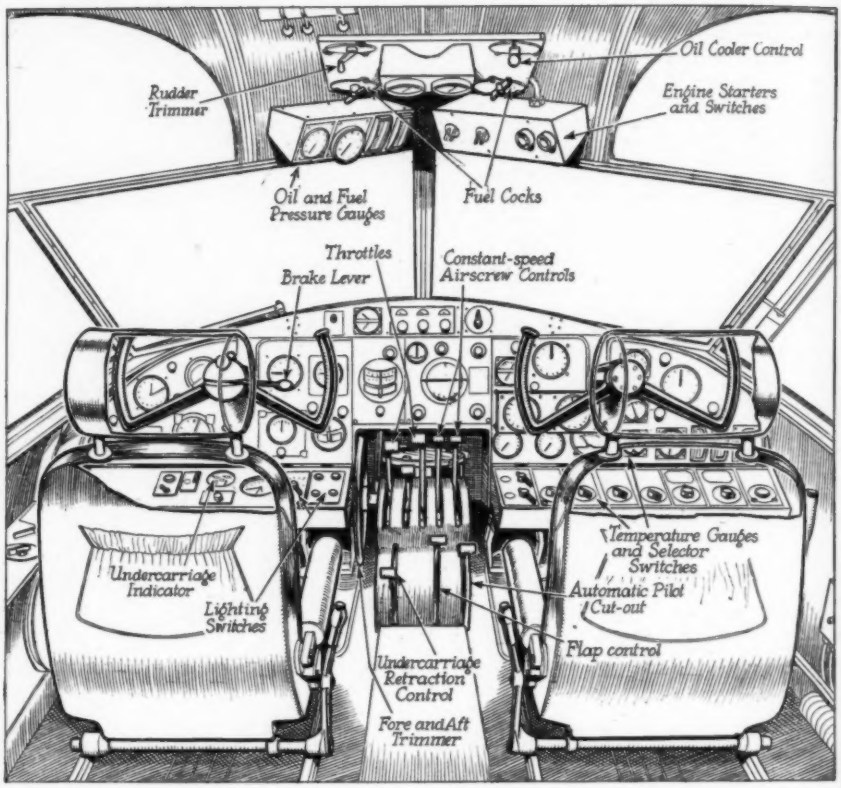
This development is one of considerable importance since only the major airline companies at present run departments specially for this purpose—and instruments, a word which includes all manner of devices both electrical and otherwise, are nowadays among the most important items in aircraft equipment. The new Rollason shops, which are at present being laid out, will look after all the usual free and restrained gyro instruments, thermo-couples, wireless and electrical equipment generally.

At the moment the shops at Croydon are intensely busy with unmentionable modification and rebuilding work for the R.A.F., and practically all the civil work, other than a certain amount of straightforward maintaining, is carried out at Hanworth.

Another equally important and coincident occurrence at Rollasons has been the acquisition of the distributionship agreements—in the United Kingdom and Eire—for the American Wright engines, their accessories and spare parts, including such things as the Chandler-Groves carburetter. Additionally they have made similar agreements with the Lewis instrument people—specialists in thermo-couples and temperature gauges—for Magnaflux crack detector equipment, and for Martin Decker cable-tension indicators.

THE NINETY-FIVE IN THE AIR

Details of the Control and Instrument Lay-out : Some Remarks on the Flying Characteristics



The control-cabin of the prototype D.H. 95. In production machines the controls and instruments in the roof will be mounted on a single panel, but otherwise the layout shown is substantially that which will apply to later machines. The depth of the windscreen is noteworthy ; coupled with a short nose, this gives the crew an exceptionally good field of view.

WHEN flying in the control cabin of the 95, two points are particularly striking. The first is concerned with the obviously good flying characteristics, which are especially noticeable and important at low speeds—during and after the take-off and during the last phase of the approach. The second is the simplicity of the control layout. One has become accustomed in modern transport, and, for that matter, in military aeroplanes, to the need for dealing with a very vast number of items which are disposed more or less irregularly all over the control cabin. In the Flamingo every essential item is conveniently placed, and no operation, whether lowering the undercarriage and flaps, or resetting the trim, requires any sort of exertion or thought.

Two of the more important features which go to make one feel thoroughly at home in the cockpit are the good view, both while flying level and while taxying in the tail-down position, and one's comparative nearness to the ground. The latter effect, which is characteristically the result of the high-wing layout, should make the hold-off and landing exceptionally straightforward, while there is no very marked change of attitude when the control column is brought fully back for the landing.

Crew Comforts

The dual controls, incidentally, have a direct fore and aft movement through the dashboard, so that there is no inconvenient column in the cabin itself, and each is more or less instantaneously adjustable for length. At the same time, the seats have the usual means of adjustment both in the fore and aft and the vertical directions, so that it should be possible to tailor the 95 to suit a pilot of any possible stature.

At all speeds it seems that the machine is fully stable fore and aft, and the incorporation of an additional central fin has removed all traces of the directional instability which was apparent when the prototype was first flown. Certainly, in a level attitude and at cruising speed the machine flies by itself, and any mass demonstrations by the occupants of the main cabin can be felt and corrected at once by a movement of not more than an inch or two of the large trimming wheel which is placed on the left of the central control bank.

The less-used rudder bias gear is arranged in the form of a crank in the roof. With the latter are the master fuel taps, the tail-wheel lock, the oil cooler control, the slow-running cut-out, and the carburetter heater control. Since the floor of the control cabin is a good deal higher than that of the passenger compartment (with the freight and mail compartment underneath), the roof is comparatively low, and the various controls can easily be reached.

Below the throttle and constant-speed airscrew control quadrants in the central bank are somewhat similar controls for the undercarriage, flaps and automatic pilot. The use of the first two is simple and quick in the extreme, and this rapidity is repeated in the action of the hydraulic operating gear itself. The undercarriage legs, after the lever has been pulled up to the top of its quadrant, come up smoothly and are fully retracted in something like ten seconds. Once they are up (or locked in the down position) the lever is moved to "neutral." A safety locking device, in the form of a pinned stop, is incorporated in the quadrant so that the undercarriage cannot be retracted by accident while the machine is on the ground. Any flap angle may be selected by leaving the control in the required position. Ordinarily, an angle of 25 degrees is used for take-off, and this position is clearly marked.

Normally, the 95 is brought in over the last part of the approach at an airspeed of about 85 m.p.h., and at this speed the machine is stable in all axes and with adequate remaining control. In bumpy weather, or with a full load, 90 m.p.h. would probably be the figure. Needless to say, the engine-off flaps-and-undercarriage-down attitude is quite steep, and height is lost with extraordinary rapidity. In fact, one's impressions during a first approach are that the machine must be over-shooting the landing ground.

The instrument group, apart from the centrally disposed Sperry panel, is in two main units, which may be removed completely or hinged open while in flight. Each of these

units consist of two parts—the main panel, which is mounted on special shock-absorbers, and the rigidly mounted sub-panels. As explained elsewhere, the backs of these instruments may be reached for test or examination simply by hinging open the nose of the machine.

The left-hand panel on the dashboard carries all the essential flying instruments, while the right-hand panel is devoted mainly to engine speed, boost and temperature gauges, though for the benefit of the second pilot, there is an airspeed indicator and a sensitive altimeter. The separate panels carry the usual operating switches and subsidiary indicators, and the entire wiring of the dashboard incorporates plug and socket connections which permits the boards to be quickly and easily detached.

Very little can be said by the ordinary interested co-pilot about the handling characteristics except that these are as normal and straightforward as they should be. The ailerons, even at a cruising speed of 205 m.p.h., are quite light for the size of the machine, though a good deal of pressure is required on the rudder pedals to instigate a turn.

Cursory impressions suggest that the control reactions are likely to be more suitable for blind-approach conditions than those to which one has become accustomed in modern transport aeroplanes. Usually, the short, sharp turns, which must be made while holding the equi-signal track, can only be done on the ailerons, but with the 95 it seems that it will be possible to make such corrections on the rudders—a fact which simplifies both directional gyro and beam flying. The fast machine of to-day is much too stable directionally, and the application of rudder (with great difficulty) induces nothing more than a yaw, with little or no deviation from course.

This, of course, is purely an impression, and only in actual service will it be possible to see whether the machine is more than usually suited to blind-approach work.

The official speed figures for different heights and powers are given elsewhere, and, without any knowledge of possible position error, A.S.I. readings are not of any great value. While flying level for a matter of ten minutes or a quarter of an hour at 10,000ft., however, the reading was round about 180 m.p.h., which, corrected for altitude, gives a true speed of some 210 m.p.h. The revolutions were about 2,200, and the boost pressure −2 lb./sq. in., figures which suggest an average output from each engine of approximately 500 h.p., or 60 per cent. of the maximum available power. H. A. T.

The Stratoliner on Test

THE majority of the makers' tests with the Boeing 307 Stratoliner have now been completed, and the C.A.A. tests will be carried out concurrently with those involved in the tryout of the pressure cabin equipment which is now being installed.

Apparently, the machine has exceeded the 240 m.p.h. top speed which was originally estimated, while the take-off runs, too, are well up to expectations. When loaded to an all-up weight of 41,000 lb. the machine takes a run of 750ft., and when loaded to its maximum of 45,000 lb. it is off the ground in 1,000ft. The rate of climb with 41,000 lb. is 1,400ft. for the first minute, and, at the maximum all-up weight of 45,000, is 1,000ft. in the first minute.

Airport Annual

AT last Friday's Croydon airport staff dinner and dance the somewhat extraordinary number of the toasts can only be explicable when considered in relation to the vast number of people present. Actually there were more than four hundred guests—a figure which gives one a real idea of the importance of our leading airport—and no fewer than eight speakers, led by Sir Edward Campbell, who was representing Sir Kingsley Wood.

In proposing the toast of "All firms and operating companies," Sir Edward, after speaking of his long association with and admiration for Sir Kingsley, apologised for the inconvenience which would be caused by the various improvements which were now to be made at Croydon for the ultimate good of all concerned. He alluded to the international airport population as a "league of nations which worked" and welcomed the representatives of foreign airline companies.

Mr. J. W. S. Brancker, the local manager of Imperial Airways, in his reply, suggested that Mr. Bouderie, Air France's Croydon manager, who was one of the airport's oldest inhabitants, should really have been speaking in his place. In spite of the sentimental value attached to the Croydon hills and dales, he felt that no improvements could be made too soon, and added a word of praise for the work of Air Commodore Robertson, the airport manager, in "bending unbendable regulations" to suit special circumstances.

Later in the toast list, Air Commodore Robertson himself, replying to Mr. Farey Jones, made the interesting statement that during January and December there had been a 50 per cent. increase in passenger traffic.

K.L.M.'s To-morrow

THIS year's K.L.M. plans include, in the West Indies, a service to Paramaribo, the capital of Dutch Guiana. The company already operate services from Curaçao, their base, to Trinidad and Barbados. These West Indies services are particularly interesting now because the company has ideas about a transatlantic service, and will be co-operating with British Airways on their Lisbon run as soon as this has been started. Presumably, the service will be via the Cape Verde Islands.

For three weeks during the summer K.L.M. will be running through to Helsingfors in co-operation with A.B.A. and Aero, and for four months after June 1 they will be running to Oslo in co-operation with D.N.L.

On page 167 it is explained that K.L.M. are provisionally ordering six D.C.4s and definitely ordering four D.C.5s. In this connection Mr. Guilonard, the technical director of the company, has left for America, where he will also make a study of the Boeing Stratoliner, or 307, the Boeing 314 flying-boat, and the Curtiss 20 transport. The D.C.5s will be used only for internal services and will be equipped to carry twenty-two passengers. The D.C.4s will have pressure cabins for high-altitude long-distance work, the idea being to fly at 14,000ft. by day and night on the Batavia route. At this height, and at a cruising speed of 202 m.p.h., the K.L.M. version of the D.C.4 will have a range of 1,700 miles in still air, and the new fleet will cut the Batavia schedule down to about 2½ days—or 3½ days to Sydney. Ten years ago, when the Batavia service was first started, the journey took 18 days.

During last year 147,000 passengers were carried on the K.L.M. European routes, 6,000 on the Batavia route, and 10,000 on the West Indies services. The corresponding figures for the previous year were 111,000, 4,000, and 6,000. Altogether, the passenger total increased from 121,000 to 162,000—a rise of 34.1 per cent.; mail and freight loads respectively increased by 30.5 per cent. and 42.9 per cent.

Beech and Beechcraft

THE free-for-all New York-Miami air race, which was held on January 7, was won by Mr. M. Constant, flying Miss Cockrane's Wasp Junior-engined Beechcraft at an average speed of 204.23 m.p.h. for the distance of 1,195 miles. Mr. R. Holderman, with a Lockheed Twelve, was only 38 seconds behind Constant. His average speed was 204.07 m.p.h. Mr. Constant's Beechcraft is a special version of the D.17 type.

The latest and most popular of the single-engined Beechcraft is the F.17.D, which is powered with a 330 h.p. Jacobs radial. With a fixed-pitch airscrew this type cruises at 177 m.p.h. at 8,000ft. while carrying five people and their baggage. Nowadays the Beechcraft, for which the agents in this country are Surrey Flying Services of Croydon, has a wider cabin and a somewhat lengthened undercarriage-to-tail-wheel-base which has removed the slight tendency in the older machines of pitching during the landing run. The ailerons are now on the upper wing, which is the last to stall, and the place on the lower wing originally taken by the ailerons now carries electrically operated camber-changing flaps. The F.17 has an electrically operated retractable undercarriage.

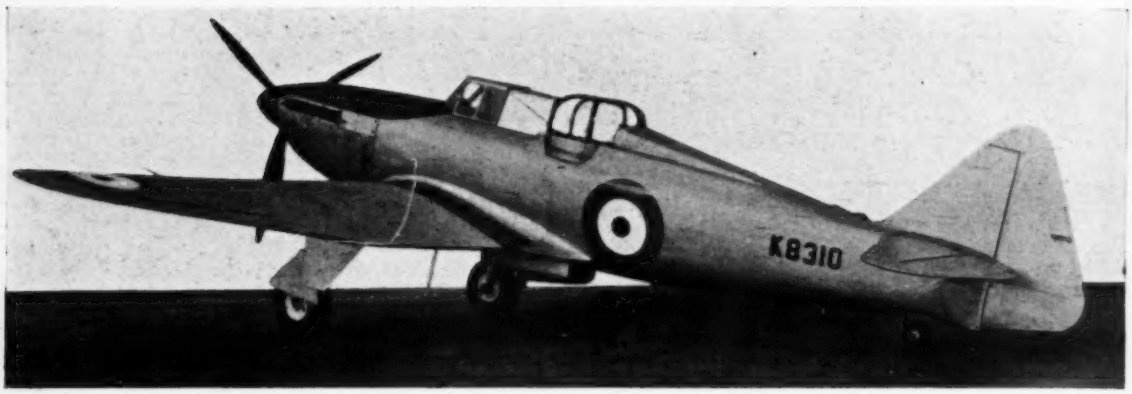
Although it is early to make any definite statement on the subject, it is quite well known that North-Eastern Airways, finding no really fast machine suitable for their operations in this country, are thinking of buying a small fleet of American transports, and a machine being favourably considered at the moment is the Twin Beech. North-Eastern Airways require something which will cruise at, or at more than, 200 m.p.h. while carrying a pilot and co-pilot (the latter normally the radio operator) and not more than six or seven passengers.

Recently Surrey Flying Services have had their eye on a landing ground near the South Coast, and they may yet develop this for use as a C.A.G. centre. For the present the scheme does not appear to be affecting their ordinary school work at Croydon, since there are still plenty of amateur pilots and pupils who do not wish to be nationally subsidised and controlled. Only one club, that at Brooklands, has continued with its normal operations and ignored the C.A.G. scheme, though they (and Surreys) have taken a special interest in the Air Defence Cadet Corps.

SERVICE AVIATION

Royal Air Force and Official Announcements :

Fleet Air Arm News : Military Aviation Abroad



FORMIDABLE DEFIANCE : A revealing view of the Boulton Paul Defiant, our new standard two-seater single-engined fighter. It has a multi-gun power-driven turret and a Rolls-Royce Merlin engine.

A Fighter Vogue

THE constantly growing interest displayed by the Powers in the development of the twin-engined fighter is called to mind by the reports in the daily Press of an accident to a new Lockheed machine of this description which is reputed to have attained a speed of nearly 400 m.p.h. This aircraft was damaged when its pilot crashed near Mitchell Field, Long Island, at the end of a 2,400-mile flight from Riverside, California, made in 7 hr. 45 min. It is stated that the machine concerned is a low-wing type equipped for (sub?)-stratosphere operation, fitted with two 1,000 h.p. Allison engines and armed with "a nest of machine guns."

In the multi-seater category the U.S. Army Air Corps already has the Bell pusher, and if, as it is reported, the Lockheed is a single-seater, it would appear that the U.S. Government is considering adopting bi-motor pursuit machines on a large scale.

France, Germany, Italy, and Poland have already developed various types of two-seater twin-engined fighter, but so far no announcement has been made of a single-seater with two power plants, excepting the experimental Fokker shown at Paris last year.

Many years ago the Boulton Paul company constructed a single-seater fighter with two Lynx engines, though it was never adopted for service. It may be assumed that the British Air Ministry and our manufacturers are fully alive to the merits and drawbacks of twin-engined craft for fighting and that any development work considered necessary is proceeding.

As suggested in *Flight* many months ago, the Bristol Blenheim would make a very useful type on which to train pilots of such specialised craft.

Consolidated Offered for R.A.F.

ACCORDING to Aviation Corporates, Ltd., London representatives of the Consolidated Aircraft Corporation of San Diego, California, the latter concern has placed all the drawings, designs, jigs, tools, and dies for the production of the PBY-4 twin-engined flying boat at the disposal of the British Government. Alternatively, they have offered the present factory output of these boats.

Air Activity in Kenya

SINCE the formation of No. 223 (B) Squadron at Nairobi not much news about that unit has come through. It has not been idle, however, and during the early part of the winter five Wellesleys of the squadron made an extensive tour in East Africa, flying to Abercorn, Livingstone, Buluwayo, Salisbury, Broken Hill, and M'Beya. No doubt the more air-knowledgeable inhabitants of those places were much cheered and interested to see machines of the same type as those which recently broke the world's long-range record.

The Indian Air Force

THE Indian Air Force is a new creation, and it is yet small in numbers, but it is beginning to take an active part in operations on the North West Frontier. A few months ago a Wapiti of this force, with a Sikh officer as pilot and another Sikh as air gunner, was dropping notices to say that air action was to cease in a certain district, when the engine failed. It is thought that a fuel supply pipe had been shot through, which suggests that the district had not been completely pacified. At any rate, the machine had to land, and came down on top of some tall trees. Both men were slightly injured, but they got down to earth and succeeded in escaping from some tribesmen. The latter stopped to collect ammunition from the Wapiti, which gave the two Sikhs a chance to get away. They hid in a cave that night, and next morning reached a British post.

New Technical School

A NEW School of Technical Training for Men (No. 5) has been opened at Locking, near Weston-super-Mare, and placed within No. 24 (Training) Group, Halton. This is the second school for the technical training of airmen to be opened in recent months, as No. 4 was formed at St. Athan, Glamorgan, on September 1, for the training of flight mechanics and flight riggers.

The Air Force List

THE February issue of the *Air Force List* has now been published. It can be purchased (price 4s.) from H.M. Stationery Office at the following addresses: Adastral House, Kingsway, London, W.C.2; 120, George Street, Edinburgh; 2, York Street, Manchester; 1, St. Andrew's Crescent, Cardiff; 15, Donegall Square, Belfast; or through any bookseller.

Flying Accidents

THE Air Ministry regrets to announce the following accidents—

A.P/O. Francis Joseph Hamell lost his life and F/O. Edward Reginald Berrill (pilot) was slightly injured in an accident which occurred near Market Drayton on February 7 to an aircraft of No. 10 Flying Training School, Tern Hill, Shropshire.

Sgt. Ralph Herbert Wright (flying solo) lost his life in an accident which occurred near Cambridge on February 5 to an aircraft of No. 22 Elementary and Reserve Flying Training School, Cambridge.

Sgt. Alan Vincent Hancock (flying solo) lost his life in an accident, which occurred at Radwinter on February 7 to an aircraft of No. 1 (Fighter) Squadron, Tangmere, Sussex.

EMPIRE DEFENCE

NEXT week's issue of FLIGHT will be a Special Number dealing with the Empire Air Forces. Illustrated articles will describe the work and equipment of the Air Forces administered by our Dominions, Colonies, Protectorates and certain Allied Kingdoms, as distinct from the Royal Air Force overseas.

Next Thursday FLIGHT *February 23*

Royal Air Force Gazette

Royal Air Force

General Duties Branch

P. E. W. Walker (from Reserve) is granted a short-service commission as Pilot Officer on probation (January 25).

The following Acting Pilot Officers on probation are graded as Pilot Officers on probation on the dates stated:—D. Redington (January 14); C. L. Roy, K. V. Wendel (January 17).

The following Flying Officers are promoted to the rank of Flight Lieutenant on the dates stated:—J. B. Brolly (January 16); N. B. R. Bromley (Acting Flight Lieutenant); E. W. Thornewill (January 27).

The following Pilot Officers are promoted to the rank of Flying Officer on the dates stated:—H. P. Pleasance (Acting Flying Officer) (December 11, 1938); M. T. St. J. Pattle (December 29, 1938); H. B. M. Pearson (January 8); A. J. Hudson (January 29); H. N. G. Wheeler, W. E. M. Lowry, A. R. Oakeshott, M. S. Donne, P. G. Wykeham-Barnes, W. E. G. Measures, G. V. W. Kettlewell (January 31); J. D. Stephens (February 3); H. E. Vickery (February 6).

The following Flying Officers are granted the acting rank of Flight Lieutenant on the dates stated:—P. H. Bragg (January 14); E. G. Rogers (January 16); N. A. N. Bray, D.F.C. (January 23).

P/O. J. G. Cave is granted the acting rank of Flying Officer (January 2); Wing Cdr. R. Pyne, D.F.C., is seconded for service under the Turkish Government (January 18); Sqn. Ldr. E. C. Hudleston is seconded for service under the Turkish Government (January 12); Flt. Lt. L. B. Bowdler King is seconded for service under the Turkish Government (January 12); Lt. Cdr. R. E. Gunston, R.N., is re-attached to the Royal Air Force as a Squadron Leader with effect from January 27 and with seniority of July 1, 1938; Flt. Lt. D. C. J. Miller (Captain, 17th/21st Lancers) ceases to be seconded to the Royal Air Force on return to Army duty (January 25); P/O. P. A. Burnell-Phillips resigns his short-service commission (February 1); the short-service commission of Acting Pilot Officer on probation D. H. Howell is terminated.

Equipment Branch

Pilot Officer on probation R. G. J. White is confirmed in his appointment and promoted to the rank of Flying Officer (Jan. 10).

The following Flying Officers are granted the acting rank of Flight Lieutenant (February 1):—H. M. C. Harwood, H. Stones.

Medical Branch

The following are granted short-service commissions as Flying Officers for three years on the active list (January 23):—K. B. Redmond, M.B., B.S., M. O. Richardson, M.R.C.S., L.R.C.P.

Commissioned Engineer Officers

The following Flying Officers on probation are confirmed in their appointments (January 20):—P. Hall, M.B.E., A. Hanglin.

Commissioned Signals Officer

Flight Officer on probation G. D. D. Gammack is confirmed in his appointment (January 12).

Commissioned Armament Officer

Flying Officer on probation W. S. Bow, M.B.E., is confirmed in his appointment (January 20).

Memoranda

The permission granted to C. L. W. Brading to retain the rank of Lieutenant is withdrawn on enlistment in the Auxiliary Air Force (May 27, 1938); the permission granted to L. Nicholson to retain the rank of Lieutenant is withdrawn (January 2)

Royal Air Force Reserve

RESERVE OF AIR FORCE OFFICERS

General Duties Branch

The following are granted commissions in Class CC in the ranks stated and on the dates stated:—Flight Lieutenants: Flt. Lt. R. J. Twamley, R.A.F.O. (September 19, 1938); Major F. R. Dickinson (Sp. U.L., I.A.) (September 21, 1938); Lt. E. M. Wright (October 1, 1938); Major J. Lothian (I.A. Ret.) (October 24, 1938); Capt W. Mitton (October 31, 1938); Capt. P. R. W. Carthew (R.A.R.O.) (November 7, 1938); Major A. C. S. Hall (December 1, 1938); Capt. F. J. Sherman (Sp. U.L., I.A.) (December 12, 1938); Capt. T. G. B. Sutherland (R.A.R.O.) (December 19, 1938). Flying Officers: Lt. Cdr. J. H. Fuller (R.N.R.) (October 1, 1938); Lt. J. A. Beeney, D.F.C. (December 1, 1938); Lt. L. B. Felton, Lt. L. E. G. Hawkins, Capt. F. A. Rundall (R.A.R.O.) (December 12, 1938).

F/O. F. B. Taylor, R.A.F.O., is granted a commission in Class CC as Flying Officer with the acting rank of Flight Lieutenant (September 12, 1938).

The following Pilot Officers on probation are confirmed in their appointments on the dates stated:—C. Clarke (November 20, 1938); A. G. Hall, R. G. Burke, J. A. Newton, T. W. Hamlin, W. H. L. Dudley (January 6).

The following Acting Pilot Officers on probation are confirmed in their appointments and graded as Pilot Officers on the dates stated:—F. H. Butcher (January 15); K. Bell, D. C. Carleton, K. A. Cockerell, H. L. Derwent, J. F. Grady, P. J. C. Harper, J. R. B. Hartnoll, W. R. Hole, J. L. Kemp, T. Kerr, E. K. Kitson, J. Lingwood, R. Marples, R. A. Marsh, C. H. Robinson, G. W. Stanhope, W. Surtees, G. I. Thomson, G. B. Treasure, C. P. L. Wilcock, J. C. M. Wilson, M. D. H. Wilson, W. S. Worner (January 17).

F/O. G. F. E. Harrison is transferred from Class C to Class CC with effect from May 7, 1938, and is granted the rank of Flight Lieutenant (October 1, 1938); F/O. B. P. Jones is transferred from Class A to Class C (November 2, 1938); Flt. Lt. (Honorary Sqn. Ldr.) W. E. Reason (Squadron Leader, R.A.F., Ret.) relinquishes his reserve commission on completion of service (October 24, 1938); P/O. T. S. Tull relinquishes his commission on appointment to a commission in the Royal Air Force Volunteer Reserve (December 20, 1938); P/O. P. E. W. Walker relinquishes his commission on appointment to a short-service commission in the Royal Air Force (January 25); Acting P/O. R. V. Henderson relinquishes his commission on appointment to a commission in the Reserve of Officers, Royal Canadian Air Force (General List) (October 1, 1938).

Equipment Branch

Major G. H. Ruse (I.A. Ret.) is granted a commission in Class CC as Flight Lieutenant (November 8, 1938); Flt. Lt. F. J. B. Powell, M.B.E. (R.A.F. Ret.), is granted the honorary rank of Squadron Leader (September 5, 1938).

Royal Air Force Volunteer Reserve

General Duties Branch

T. S. Tull is granted a commission as Pilot Officer with effect from December 20, 1938, and with seniority of December 22, 1936; R. C. L. Brayne is granted a commission as Pilot Officer (February 7).

Auxiliary Air Force

General Duties Branch

No. 502 (ULSTER) (GENERAL RECONNAISSANCE) SQUADRON.—The following Pilot Officers are promoted to the rank of Flying Officer on the dates stated: J. G. C. Bell, W. H. McGiffin (January 1); Y. J. Kirkpatrick, W. M. May (January 10).

No. 503 (COUNTY OF LINCOLN) (BOMBER) SQUADRON.—F/O. O. Hellyer is transferred to No. 616 (South Yorkshire) (Fighter) Squadron (November 1, 1938).

No. 600 (CITY OF LONDON) (FIGHTER) SQUADRON.—Flt. Lt. P. K. Devitt relinquishes his commission (September 13, 1938).

No. 607 (COUNTY OF DURHAM) (FIGHTER) SQUADRON.—The following Flying Officers are promoted to the rank of Flight Lieutenant (January 7): J. Sample, J. R. Kayll.

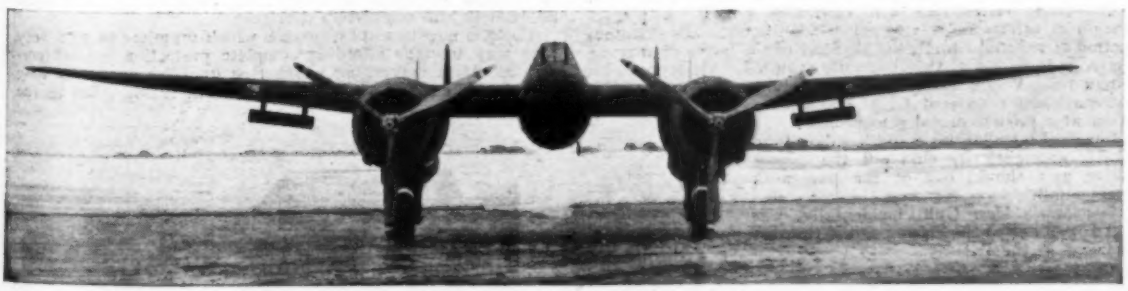
No. 609 (WEST RIDING) (FIGHTER) SQUADRON.—P/O. P. H. Barran is promoted to the rank of Flying Officer (October 20, 1938).

No. 907 (COUNTY OF MIDDLESEX) (BALLOON) SQUADRON.—G. A. Usher is granted a commission as Acting Pilot Officer (January 18).

No. 909 (COUNTY OF ESSEX) (BALLOON) SQUADRON.—Acting P/O. the Hon. H. J. A. Seely is promoted to the rank of Flying Officer (January 2).

No. 919 (WEST LANCASHIRE) (BALLOON) SQUADRON.—O. S. Neill, A.F.C., is granted a commission as Squadron Leader and appointed to the command of the squadron (January 25).

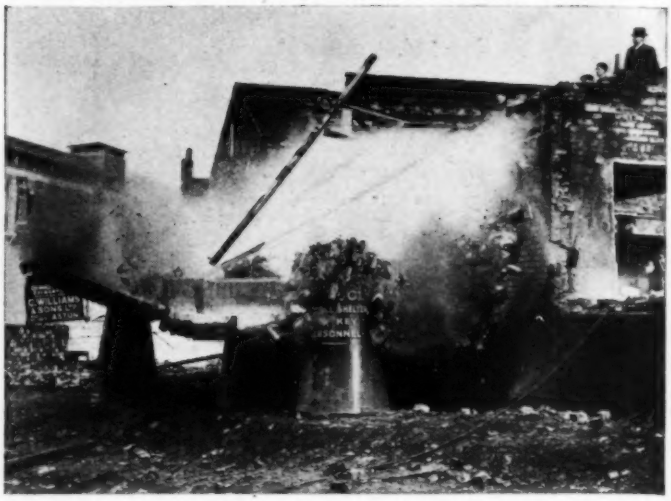
The following are granted commissions as Pilot Officers (January 25): W. M. S. Fox, F. G. Gaskin, C. L. Lomas, W. G. Redmond.



TWIN-ENGINED DIVE BOMBER: A Fokker G.1 (*Faucheur*) of the type which is to be built under licence by the Danish Government. It has two Bristol Mercuries and special flaps under the wings for limiting speed to about 300 m.p.h. in a bombing dive. During a 3,000-foot dive it can do a 180 deg. aileron turn. In this photograph the flaps are down; when raised they are merely turned edge on, and do not retract flush with the wing. The machine, incidentally, is not balancing on its wheels; a tail trestle has been "liquidated."

The INDUSTRY

Instrument-drive Equipment : Plating Magnesium Alloys : the B.I.F. : Sub-contract Enterprise



CRUMP ! Three of the "Consol" movable air-raid shelters for key personnel, made by Constructors, Ltd., of Erdington, Birmingham, and recently referred to in these pages, were subjected last week to this severe test. The occupants emerged smiling

The Leipzig Fair

THIS year's Leipzig Spring Fair, which will be on an even larger scale than before, is now drawing near; it will be held from March 5 to 13. Mass-production machine tools will be a feature of the engineering section.

Full details, including particulars of reduced travel rates, are obtainable from the London office of the Leipzig Fair, First Avenue House, 45, High Holborn, London, W.C.1 (Holborn 1408-9).

British Timken Appointment

BRITISH TIMKEN, LTD., announce the appointment of Mr. D. McNicoll, B.Sc., as export sales manager. This is a new post created to assist in the management of the still increasing export business which the firm is undertaking.

Sqn. Ldr. G. H. Reid Lectures in Dublin

THE Eire Minister for Defence, Mr. Frank Aiken, was amongst the audience when Sqn. Ldr. G. H. Reid, managing director of Reid and Sigrist, Ltd., lectured to the Royal Dublin Society on "Recent Progress in Aviation."

Sqn. Ldr. Reid told a correspondent that he proposes to visit Dublin again in the near future to demonstrate the Reid mid-wing monoplane to Defence Ministry officials and Army Air Corps officers at Baldonnel aerodrome.

For Instrument-driving

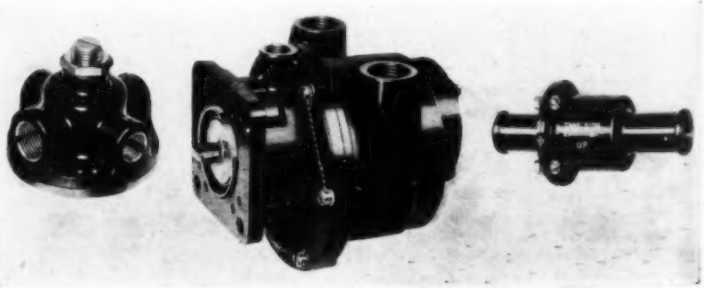
VACUUM pumps are tending to supersede the venturi-tube method of instrument operation in aircraft. The two obvious advantages of the one type over the other, apart from aero-dynamic ones, are that an engine-driven pump produces full instrument sensitivity, both during the warming-up period on the ground and at high altitudes, and it is not subject to icing-up. In addition, provided its capacity is sufficient, the pump removes the danger of sluggish instruments at low flying speeds.

Rotax, Ltd., of Willesden Junction, London, N.W.10, have evolved a new type of positively lubricated sliding-vane pump which possesses, it is claimed, all the advantages mentioned. It is engine driven, and runs at approximately 1½ times engine speed. This pump, which is known as the B-2A, will provide sufficient suction for operation of a turn-and-bank indicator, a directional gyro and an artificial horizon.

While one pump will be sufficient for all three instruments, a dual-pump installation will obviously provide a greater margin of safety under emergency conditions. To maintain suction at reduced r.p.m., the capacity of the pump at cruising r.p.m. is in excess of that normally required. By means of a Rotax Eclipse type AV-1 regulating valve excessive suction is automatically countered by the admission of air at a predetermined pressure.

For dual installations a check valve, type NFBJ, automatically cuts out the appropriate unit should one of the pumps or engines fail.

Henshaw's Mew Gull, incidentally, was fitted with one of these pumps, and they are installed in the D.H.95.



The Rotax "Eclipse" engine-driven vacuum pump, with suction regulator (left) and check valve.

Lighting a Factory

IN the new Cunliffe-Owen Aircraft factory at Southampton, the shops are lit by the G.E.C. "Osira" mercury-vapour system, and the drawing office by "Osram" bulbs in "Crysteel" angle lamps. Installation was by the Benjamin Electric Co., Ltd. It may be recalled that in our recent description of the building we commented on the excellence of the lighting.

Unsubsidised Engine Production

AT the annual dinner of the airscrew and engine divisions of the De Havilland Aircraft Co., Ltd., held at Harrods last Friday, Major G. P. Bulman, of the Air Ministry, referred to a fact which is too often overlooked, i.e., that the astounding success and popularity of De Havilland engines have been achieved entirely without Air Ministry subsidy, purely on their merits in the commercial markets of the world.

Mr. Alan S. Butler, chairman of the company, outlined the year's progress and successes. When referring to Henshaw's recent flight to the Cape and back, he said it took a Gipsy to beat a Gipsy, to which Major Halford whispered the correction that it took a Gipsy to beat two Gipsies.

Mr. J. J. Parkes, in proposing the toast of the guests, expressed the hope that airscrews would soon be included in Major Bulman's official title. [Major Bulman is both Director of Engine Production and Deputy Director of Research and Development (Engines).]

Plating of Magnesium Alloys

THE mechanical properties of magnesium and its alloys are such as to make these metals very attractive to the aircraft and aero engine engineer for certain purposes. The adoption of magnesium alloys would have been more rapid and more extensive than has been the case had it not been for the fact that the fear of corrosion has deterred designers. Protective surface coatings have been successfully applied to magnesium and have been found to give a considerable measure of protection, but there is still some way to go before the corrosion difficulty can be said to have been adequately and completely overcome.

There is now news of a process which promises to go a very long way towards affording complete protection against corrosion. Data concerning weathering qualities over very long periods are not yet available, for obvious reasons, but as the

process enables magnesium alloys to be plated by any of the normal plating processes there does not seem to be any reason to expect trouble after a long lapse of time.

The new process, which is the joint invention of Mr. F. C. Katon and Mr. H. Webb, is cheap, rapid and apparently not in the least " temperamental," so that there is good reason to think that it can be carried out by semi-skilled operators.

First, the magnesium part to be treated, which can be in the form of sheet or castings, is immersed in an aqueous bath for a couple of minutes. It is then swilled in cold water and placed in a special zinc bath, where it remains for ten to fifteen minutes. After removal from the zinc bath the article is again swilled, and is then ready for plating by any of the usual processes.

Polished sections of " keyed " magnesium plate show, under a 500 times microscopic examination, complete regularity and cohesion of the zinc to the magnesium, indicating that the " keying " has been absorbed into the zinc coating and forms a perfect adhesive bond. The uniformity of the zinc coating is rather remarkable. The microscopic examination also showed that the surface structure remains unimpaired after treatment, and pieces of treated metal exposed to ordinary atmospheric conditions showed no signs of deterioration after several months' exposure.

No traces of galvanic action between the magnesium and the deposits have been found, and heavy chromium deposits on castings and sheet have shown no signs of reaction.

The application of this process to rubber bonding through brass is a natural corollary, and certain tests carried out on behalf of the inventors by the T. B. André Rubber Co., Ltd., have shown conclusively that when the magnesium is treated by the Katon-Webb process the bond between rubber and magnesium is as strong as that between rubber and steel. We ourselves witnessed one of these tests at the André works last week. The tensile test piece sustained, without breakage, a load of 2,142 lb., which corresponded to a pull of 920 lb./sq. in.

That there will be a great many applications of the Katon-Webb process to aircraft work is obvious. Perhaps the component which has the most strenuous time is the airscrew, and it would appear that chromium plating of magnesium airscrew blades would afford complete protection not only against corrosion, but against damage by rain and hail. Should a rubber coating of the blades be preferred, and this might have certain advantages, it can be applied without any difficulty.

Messrs. Katon and Webb (of 39, Greenlands Road, Staines, Middlesex) are now seeking commercial exploitation of their invention.

" Flight " photograph.

STRANRAERS AND SPITFIRES are flown with equal dexterity by Flt. Lt. A. G. Pickering, A.F.C., the Supermarine test pilot who, together with his colleague F/O. J. K. Quill, A.F.C., demonstrated the powers of the Spitfire at Eastleigh during the recent visit of Sir Kingsley Wood. Flt. Lt. Pickering is seen here " at the wheel " of a Stranraer.

At the BRITISH INDUSTRIES FAIR

AS in the past, there are a large number of exhibitors at the British Industries Fair, opening on Monday, who are known in the aeronautical industry, though not all of them will be featuring aircraft components in their displays. A list of such firms, of whose presence at the Fair we have been advised, appears below. Both sections of the Fair, at Birmingham and London (Olympia and Earls Court) remain open from February 20 until March 3.

Exhibitors at Birmingham

Accles & Pollock, Ltd. (D.510).
Accles & Shelvoke, Ltd. (A.321 & 216).
Aerospray Manufacturing Co., Ltd. (D.722).
Aerofilms, Ltd. (B.720).
Aerograph Co., Ltd., The (D.227).
Albion Drop Forgings Co., Ltd. (D.418).
Alexander, Geo. H., Machinery, Ltd. (D.622).
Allen, Edgar, & Co., Ltd. (D.719).
Anglo-American Oil Co., Ltd. (D.306).
Association of Drop Forgers & Stampers (D.418).
Automotive Engineering Co., Ltd. (D.205).
Autoset (Production), Ltd. (D.526).
Avery, W. & T., Ltd. (D.515 & 412).
Bakelite, Ltd. (Cb.408).
Baldwins, Ltd. (Midland Branch) (Cb.222).
Bedford, John, & Sons, Ltd. (A.431 & 332).
B.E.N. Patents, Ltd. (B.627).
Birmingham Battery & Metal Co., Ltd., The (D.607 & 506).
Birmingham Electric Furnaces, Ltd. (Cb.313 & 214).
Black & Decker, Ltd. (Cb.511).
Blackburn Aircraft, Ltd. (D.110).
Britannia Batteries, Ltd. (Cb.608).
British Aluminium Co., Ltd., The (D.615 & 514).
British Insulated Cables, Ltd. (Cb.401 & 300).
British Oxygen Co., Ltd. (D.411 & 312).
British Thermostat Co., Ltd., The (Cb.700).
British Thomson-Houston Co., Ltd., The (Cb.505 & 404).
Brockhouse Engineering (Southport), Ltd. (D.709 & 606).
Broughton, J. (D.600).
Cable Makers' Association (Cb.401 & 300).
Callender's Cable & Construction Co., Ltd. (Cb.401 & 300).
Canning, W., & Co., Ltd. (Cb.215 & 118).
Cellactite & British Uralite, Ltd. (B.623 & 532).
Cellon, Ltd. (B.529).
Chatwin, Thos., & Co. (D.709 & 606).
Chesterfield Tube Co., Ltd., The (D.609 & 508).
Chloride Electrical Storage Co., Ltd., The (Cb.307).
Constructors, Ltd. (Cb.609 & 508).
Daniels, T. H. & J., Ltd. (Cb.724).
Deritend Stamping Co., Ltd. (D.418).
Desoutter Bros., Ltd. (Cb.403).
Dunlop Rubber Co., Ltd. (D.511).
Firth, Thos., & John Brown, Ltd. (D.619 & 518).
Firth-Vickers Stainless Steels, Ltd. (A.505; D.413 & 314).
Fletcher, Miller, Ltd. (D.618).
General Electric Co., Ltd., The (G.E.C.) (Cb.515 & 414).
Gent & Co., Ltd. (Cb.513).
Gilman, F. (B.S.T.), Ltd. (Cb.518).
Gledhill-Brook Time Recorders, Ltd. (Cb.719).
Guest, Keen & Nettlefolds, Ltd. (B.524).
Hall & Hall, Ltd. (D.721).
Herbert, Alfred, Ltd. (D.304 & 309).
Henley's, W. T., Telegraph Works Co., Ltd. (Cb.401 & 300).
Hughes-Johnson Stampings, Ltd., The (D.418).
I.C.I. Metals, Ltd. (D.403 & 302).
Imperial Chemical Industries, Ltd. (Degreasing) (D.305).
Imperial Chemical Industries, Ltd. (Heat Treatment) (D.204).
Incandescent Heat Co., Ltd., The (Cb.605 & 504).
Joseph, N. C., Ltd. (Cb.514).
Laycock Engineering Co., Ltd., The (D.418).
Lee, Arthur, & Sons, Ltd. (D.520).
Lewin Road Sweepers, Ltd. (D.709 & 606).
Light Metal Forgings, Ltd. (D.418).
London Aluminium Co., Ltd., The (A.411 & 310)
London & Midland Steel Scaffolding Co., Ltd., The (D.426 & B. Outdoor).
Lucas, Joseph, Ltd. (Cb.501).
Ludlow Brothers (1913), Ltd. (A.323 & 218).
Mavitta Drafting Machines, Ltd. (D.706).
M.C.L. & Repetition, Ltd. (D.406).
Metalectric Furnaces, Ltd. (Cb.605 & 504).
Midland Saw & Tool Co., Ltd., The (B.226 & 237).
Morgan, Geo., Ltd. (D.418).
Moseley, David, & Sons., Ltd. (D.630).
Newton, L. H., & Co., Ltd. (D.224).
Perry & Co., Ltd. (D.616).
Pinchin, Johnson & Co., Ltd. (B.617 & 516).
Pitman, Sir Isaac, & Sons, Ltd. (Cb.202).
Poles (1938), Ltd. (Cb.609 & 508).
Priestman, T. J., Ltd. (D.509).
Reynolds Tube Co., Ltd. (D.623 & 522)
Rotax, Ltd. (Cb.501).
Rozalex, Ltd. (Cb.722).
Rubery, Owen & Co., Ltd. (D.703 & 602).
Salter, Geo., & Co., Ltd. (A.407 & 306).
S. & D. Rivet Co. (D.704).
Sellman & Hill, Ltd. (A.307 & 202).
Serck Tubes, Ltd. (D.608).
Silvertown Lubricants, Ltd. (D.310).
Simmonds Aerocessories, Ltd. (D.421).
Smith's Stamping Works (Coventry), Ltd. (D.418).
Standard Telephones & Cables, Ltd. (Cb.401 & 300).
Sternol, Ltd. (D.720).
Taylor, Chas. (Birmingham), Ltd. (D.612).
Tecalemit, Ltd. (D.415 & 316).
Terry, Herbert, & Sons, Ltd. (B.424).
Thomas, Bertram (Cb.321).
Thor Hammer Co. (D.225).
Titanine, Ltd. (Cb.606).
Turner Bros. (Birmingham), Ltd. (D.223).
United Steel Companies, Ltd., The (D.613 & 512).
Valor Co., Ltd., The (B.401).
Venesta, Ltd. (D.725).
Voucher, Ltd. (D.614).
Wakefield, C. C., & Co., Ltd. (Cb.301).
Walker, James, & Co., Ltd. (D.422).
Ward, H. W., & Co., Ltd. (D.315).
Wellworthy Piston Rings, Ltd. (D.229).
Wickman, A. C., Ltd. (D.408).
Wild-Barfield Electric Furnaces, Ltd. (Cb.303 & 204).
Yorkshire Copper Works, Ltd., The (B.723 & 632).
Zinc Alloy Rust-Proofing Co., Ltd. (D.732).

London Exhibitors

Air Ministry (Earls Court, 217).
Bakelite, Ltd. (Olympia, A.763 & 769).
Barr & Stroud, Ltd. (Olympia, A.683).
British Airways, Ltd., and Imperial Airways, Ltd. (Earls Court, 262).
British Celanese, Ltd. (Olympia, G.1507).
British Plastics Federation, Ltd. (Olympia, A.773).
Chance Bros. & Co., Ltd. (Olympia, A.677).
Cooke, Troughton and Simms, Ltd. (Olympia, A.678).
Ebonestos Industries, Ltd. (Olympia, A.743).
Hughes, F. A., & Co., Ltd. (Olympia, A.760 & A.775).
Imperial Chemical Industries, Ltd. (Olympia, A.627 & 640).
Insulators, Ltd. (Olympia, A.761).
Jobling, James A., & Co., Ltd. (Olympia, A.801).
Lines Bros., Ltd. (Olympia, K.1833).
Model Aircraft Stores (Bournemouth), Ltd. (Olympia, J.1729).
Plantation Wood, Ltd. (Olympia, F.1325).
S. & D. Rivet Co. (Olympia, G.1554).

The Industry

SHEET-METAL SAGA

A Notable Sub-contracting Organisation Celebrates a Birthday

(Illustrated with "Flight" photographs)

Behind this imposing frontage of offices lies the main hangar-type shop of the recently completed Helliwell factory at Walsall Airport.

POLITICALLY, the first two months of the year 1889 were unimportant. Eighteen months previously Queen Victoria had celebrated the Jubilee of her accession to the Throne. Mr. Gladstone was saying a number of things, of course, but not as Prime Minister of England. He was at issue with the Tories, under Lord Salisbury, over his Home Rule Bill; in three years he had been defeated as many times.

During this balmy period the ancient little township of Dudley, cut off from the rest of Worcestershire by a "sea" of Stafford, was thriving on the progressive industrialisation of the Midlands. Bricks, iron and coal were all hers for the taking and making.

The Beginning

It was towards the end of February of that year that a youth heard of a new Dudley firm which was about to be formed by a certain Mr. Helliwell to manufacture metal fire fenders, kerbs and other forms of sheet-metal work. He wrote, applying for the post of ledger clerk—and was promptly accepted at the munificent wage of 4s. a week.

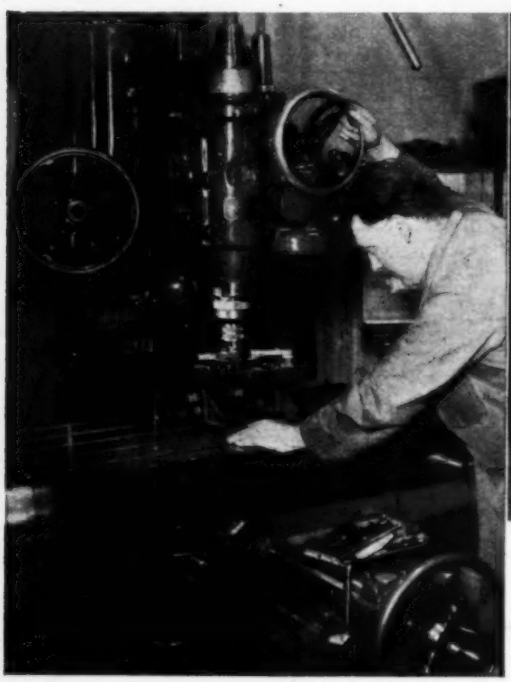
That was fifty years ago. Next week that same youth, Mr. H. Parsons, now a respected member of Helliwells, Ltd., will celebrate with his firm their respective fiftieth anniversaries of continued service—he to his company and his company to the public.

To-day Helliwells, Ltd., are one of the biggest firms of sub-contractors in the aircraft industry. With their modern plant, extensive works and up-to-date methods, they are in a position to tackle the most intricate production problems in the industry.

From working to limits of a rough and ready + or − 1in. in the old days of fenders and kerbs, Helliwells, Ltd., now work, with their precision tools and skilled workmen, to limits of + or − .0001in.

How did this change from one sphere of activity to another come about? How was it that a firm such as this, which throughout its trading history had been progressive yet typically Midland in character, should suddenly change in the course of a few years from making kerbs and fenders to handling a multitude of aircraft components?

It is an interesting tale. It is the story of a young man with those two inestimable qualities—foresight and the courage of his own convictions. This young man, with an amazing capacity for work, linked up with Mr. E. G.



(Above) Some cabin tops and windscreens are built up on a frame of light alloys which require individual assembly on special jigs.

(Left) With the aid of this No. 2a Pratt and Witney jig-borer work can be carried to limits of plus or minus .0001in. This machine is housed in a separate shop, the temperature of which is carefully regulated.

The Industry

This view of the main hangar-shop at Walsall Airport gives some idea of the layout of benches in one half of the shop.

Helliwell on the death of the latter's father, the founder of the firm. Eric Sanders is the name—a name which is already beginning to make itself heard and felt in certain quarters up and down the country.

It was in 1933, when he was but 27 years old, that Eric Sanders was persuaded by the trustees to join Helliwells, Ltd. Until then his interest in manufacturing was confined to the windscreen industry—he started as a youth in the Auster factory.

When he arrived at Helliwells, he found the works had expanded from the original small premises in Fountain Street, Dudley, to offices and works on the opposite side of the street and to even larger premises in nearby Oakeywell Street. However, the making of kerbs and fenders failed to interest him. Windscreens were, rather naturally, more to his way of thinking.

And so it was that Helliwells came to adapt as much of their existing plant as possible to the making of car windscreens.

At the start of 1936 the company's turnover exceeded £2,500 a month. Large contracts had been obtained from three vast firms in the automobile industry. Then Eric Sanders decided on a bold step. Hampered by out-of-date plant and convinced that sooner or later there would be work to be done in the aircraft industry, he decided to sell out the windscreen business, complete with plant, to his nearest competitor, in whose side he had been a very prickly thorn for some time.

This step virtually brought about a liquid state in the company's finances, the importance of which cannot be over-estimated. It enabled the company to re-construct and re-equip in preparation for the work which Eric Sanders was convinced would come as soon as rearmament was threatened.

His timing of this step bears the mark of a genius. He obtained contracts, small though they were, from Hawker, A. V. Roe and Armstrong-Whitworth, to make windscreens and cabin tops. By the end of 1936 fresh contracts began to be placed, earned on the reputation gained by the cabin tops. However, the fact was that the monthly turnover had fallen from £2,500 a month to a mere £500.

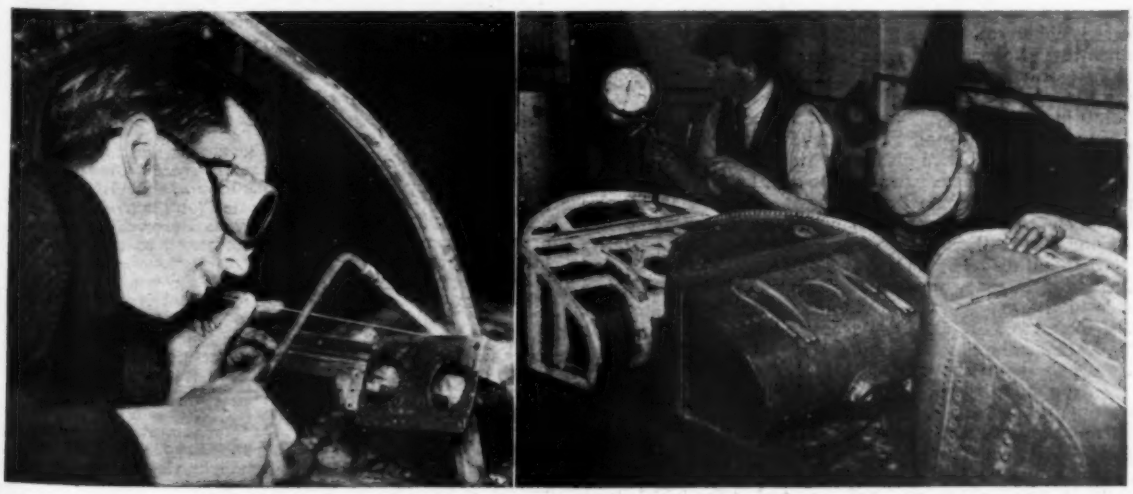
At this juncture the aircraft boom started, and Helliwells were ready to cope with the orders almost as fast as they began to pour in. Expansion had started.

Very soon it was realised that the works at Dudley were not large enough. Already one wall had been holed to allow a cumbersome and lengthy component to be removed from the shop of its birth. And so it came about that Eric Sanders and his co-director, E. G. Helliwell, decided to build a capacious factory on another site. Where was it to be and on what lines should it be evolved?

At an Airport

Looking ahead, with his own schemes definitely shaped in his mind, Mr. Sanders decided on an unusual step. He applied to the Walsall authorities for permission to build two hangar-type shops, side by side, adjoining Walsall Municipal Airport. One was to have a span of 160ft. and the other, 90ft. Across the back of the main hangar a frontage of offices was to be built. Hangar-type shops were chosen, for it is one of Mr. Sanders' many goals that Helliwells, Ltd., should one day be renowned for their aircraft.

His scheme was greeted with approval by the Walsall authorities. Plans were drawn up by Noel Proctor and Co., of Wolverhampton, and building started. The new works were urgently required. And so it came about that



(Left) For certain aircraft a light steel framework welded in predetermined sequences forms the basis for the pilot's cabin top and windscreen. (Right) Fuel tanks come "off the line" almost on a mass-production basis, to be examined, pressure-tested and finally passed out.

as soon as the roof was up, the concrete floors set, machinery and plant were moved in and work had started.

To-day the firm of Helliwells, Ltd., occupies works and offices at Dudley, more offices at Walsall, and finally the new extensive works and offices at Walsall Airport. Very soon it is hoped to consolidate at the Airport.

In Fountain Street, Dudley, are the offices, bonded stores and tool shop. At the Oakeywell Street works nearby there is a factory three floors high and with a wing at each end, where day and night shifts work throughout the week.

Briefly, the layout of the Oakeywell Street works is as follows. The ground floor of one wing and the two upper floors are devoted to sheet-metal work in its many different branches. The ground floors of the centre block and other wing house batteries of automatics.

The machine shops are well lit, and it is here that some of the latest types of machinery have been installed to the tune of over £40,000. In the main, the machines are laid out in two banks with a gangway down the centre. Down one side are seven Herbert No. 4 lathes, while three Herbert 39As, with quick releases, are on order. Similarly, there are two Butterworth automatics on order.

On the other side of the gangway there is a battery of two- and four-spindle Archdales (with overhead gate-change 4-speed controls), Alba shapers, two Soag Accuramil H.43 universals, Brown and Ward universal millers, a § Brown and Ward automatic, and a Newton profiler. But that is not quite all, for partitioned off in its own shop, the temperature of which is thermostatically maintained, is a No. 2a Pratt and Whitney jig-borer.

Making Tanks

In the sheet-metal department various types of fuel tanks are built up stage by stage by craftsmen panel beaters. Here the majority of the tanks are either De Bergue riveted or tacked and finally welded. In this department the problem of shaping baffles is quickly solved by a Selson flanging machine, which in one or two minutes will produce a neat right-angled flange round the curved edge of a baffle.

In this shop all Class 1 contracts for Vickers and Glosters are dealt with. The tanks are examined at every stage, washed in boiling water and dried by a special pure-air drying plant, before pressure-testing. Of course, there are many other types of work in hand in the sheet-metal shops, but in the main most of the work is in light alloys.

On the top floor there is a Kasenit cyanide furnace and a Kasenit muffle for case-hardening and normalising. Both are controlled by a recording pyrometer and both are of the natural draught type.

The layout in the imposing factory, with its attractive suite of offices, at Walsall Airport is as different from Dudley as chalk is from the proverbial cheese. Primarily the two shops are ultra-modern hangars. The work undertaken here is chiefly of the assembly and sheet-metal type. Row upon row of benches fill the 25,000 sq. ft. of the main shop or hangar. The services are laid under the concrete floor for the pneumatic Consolidated hand drills—there is no point in "borrowing" a drill of this type without the pneumatic plant!—and Vickers hydro-pneumatic riveters, which require boosters up to 500 lb.

The plant in these two shops is of a light semi-portable nature. Here one can watch fascinated as a Pels nibbler cleanly cuts out alloy sheets to the shape of a template. In one corner there is a Midsaw trimmer, with batteries of Denbigh drillers. In another there are Hazelwood and Dent and Sweeney presses. Conveniently situated in one side of the main shop are chromate treatment tanks (for the protection of Elektron), annealing and normalising baths (controlled by a recording pyrometer). On the other side is the paint shop.

In the main hangar, with its high sliding doors, its lofty ceiling from which are suspended powerful but non-glare mercury-vapour lamps (installed at the instigation of Rowlands Electrical Accessories, Ltd.), many different types of work are undertaken.

Here, on jigs, are mounted the steel strips which form the basis of the cabin top and windscreens of a bomber. Accuracy is obtained in the ensuing welding process by following a predetermined sequence. Windscreens, windows and panels, assembled nearby—the Perspex being rubber-mounted in alloy frames—are fitted finally to the completed framework.

The work undertaken here ranges from bulkhead frames, door ladders and doors to the delicate welding of MG7 tubes for gunners' seats. In the adjoining hangar a similar type of work is dealt with, but it is of a more "intimate" nature.

Already the offices are occupied, except for one lengthy and well-lit room on the ground floor. This vacant office is reserved for one of the most amazing installations imaginable—the Powers-Samas Accountancy plant. Strictly speaking, there are several machines serving one master machine. At the moment it is situated in the company's offices at Walsall.

This plant was installed at a cost of over £2,000 last October. To this office is sent every workman's job card. The card itself is tabulated and the workman or machine operator merely fills in the appropriate details—his number, state of work in hand, rates, etc. These cards arrive daily in thousands from each shift. A girl, with the aid of a special machine, translates the information on the card into a series of punched holes. Another girl with a similar machine repeats the process as a check—if a mistake has been made one hole will be out of register with another. In case the checker has failed to notice an error in this translation stage, all the cards are fed through a machine which, working rather on the pianola principle, locates the error and inserts a blue slip over the faulty card. This machine can deal with several hundreds of cards a minute.

In the next stage the cards are sorted out in order of serial numbers. By setting another machine, over 400 cards can be sorted and placed in their correct order in the space of one minute. They are then fed into the master accountancy machine, which translates the little punched holes into typed figures and facts, from which Mr. Sanders can see at a glance the progress made on any one job during any particular shift. It records each man's bonus or debt created each day and provides a weekly balance of time and cost recorded to each batch as against wages drawn from the bank. It records the effective operative time of each machine and it even checks the time consumed daily as against the time estimated for production. Finally this wonderful machine enters up the factories' pay roll, machine and operator's clock number, bonus, and wages, with deductions for National Health and benefits!

Little wonder it is that Mr. Sanders looks upon this machine of his as the very pulse of Helliwells, Ltd. Easy it is to realise how this firm can decide immediately whether an extra shift is necessary on any particular job.

On the eve of the fiftieth anniversary of Helliwells, Ltd., one realises how much the company's incredible progress in the last few years is due entirely to the foresight and courage of one dynamic young man, and, above all, of one who has the courage of his convictions.

The Rollason Men a-Rollicking

IT is not always possible for the outside observer to sense the happy relationship that can, in some businesses, exist between employees and their employers; but last Monday week, at the Rollason Aircraft Sports Club dinner-dance, there was no mistaking it. From the very start proceedings ran with a cheery smoothness which suggested itself as typical of the firm's work as well as of its play.

After dinner, Captain W. A. Rollason was persuaded to make a brief speech. It was the club's first dinner and he hoped it would not be the last. He went on to mention that the works was celebrating an unusual centenary—the completion of the hundredth tail-plane structure.

The next speaker was the "Rollason Men's" own managing director, Mr. F. W. Jones. He made the announcement that Rollason's would soon have the running of another very large factory. He also spoke of the craftsmanship of an ever-youthful employee, "Old Joe" to everyone, and made the announcement that the works would be closed one day next summer for an annual outing.

After dinner those who wished to dance, danced, those who preferred to talk, just talked; and those who wished to do neither danced Highland reels—for there is some good Scottish blood in the Rollason organisation.